Part No. 070-2104-00
Product Group 20

SPG1/SPG2 NTSC SYNC GENERATOR MODULES

Please Check for CHANGE INFORMATION at the Rear of This Manual

First Printing NOV 1976
Revised FEB 1987

Tektronix®
COMMITTED TO EXCELLENCE

TABLE OF CONTENTS

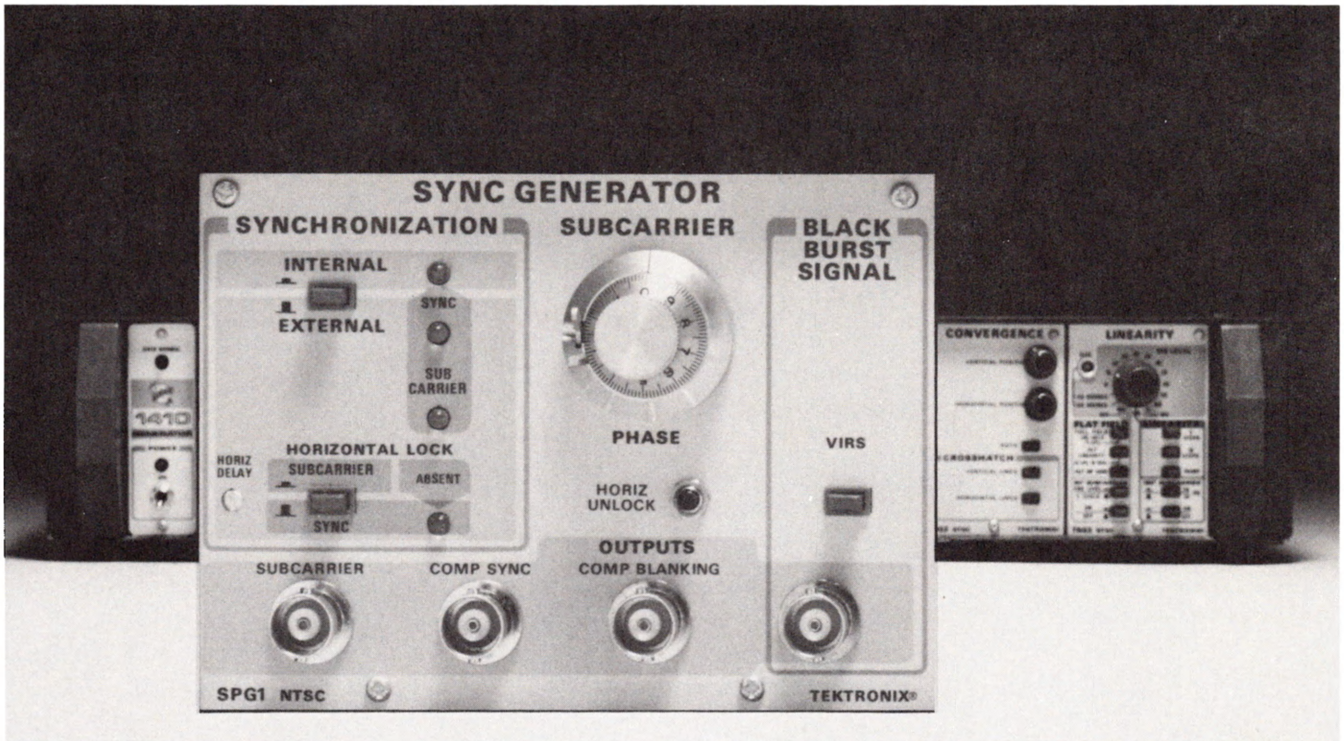
This manual is divided into two parts for safety purposes. Part I should be used by both operating and servicing personnel. Part II is to be used by qualified service personnel only. The service technician should be familiar with the Safety Summary in Part I.

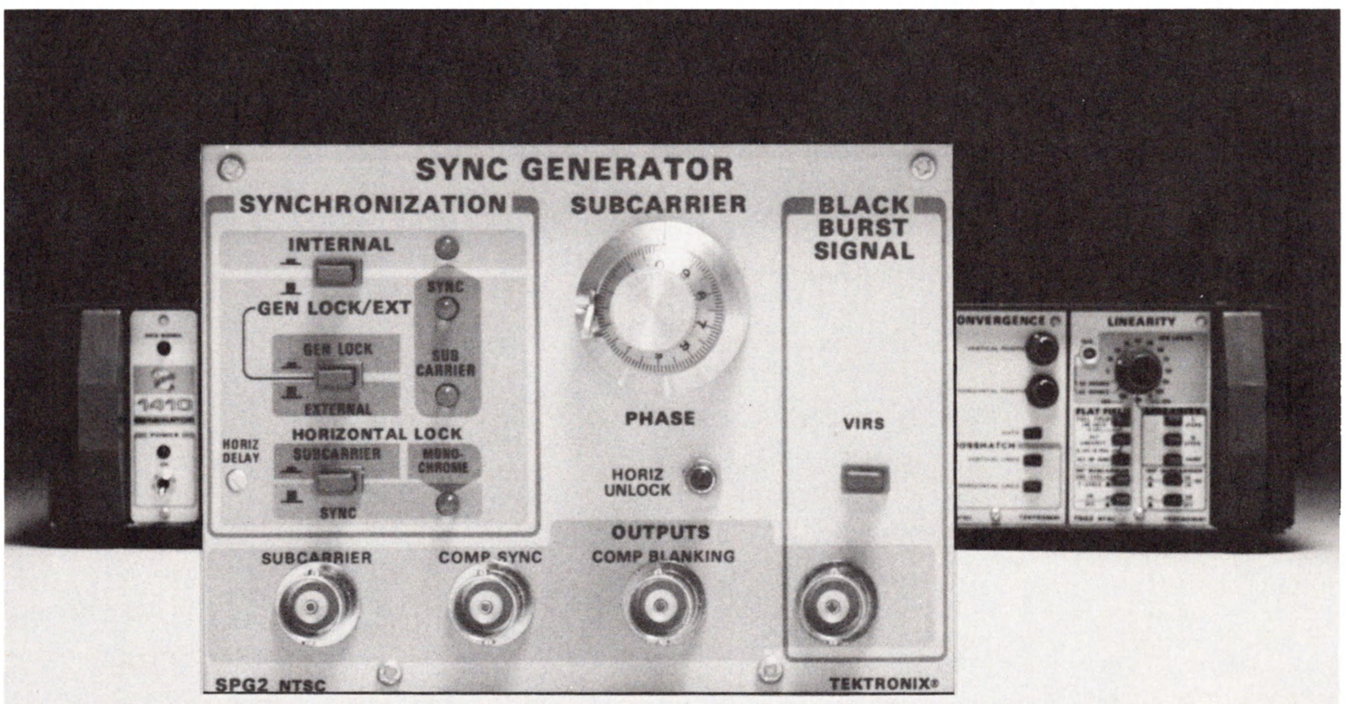
PART I — OPERATOR'S INFORMATION

PART II — SERVICE INFORMATION

WARNING

The remaining portion of this Table of Contents lists instructions that expose personnel to hazardous voltages. These instructions are for qualified service personnel only.


SYNC GENERATOR
SYNCHRONIZATION
SUBCARRIER
BLACK BURST SIGNAL
INTERNAL
EXTERNAL
SYNC
SUB CARRIER
HORIZONTAL LOCK
SUBCARRIER
ABSENT
SYNC
HORIZ DELAY
PHASE
HORIZ UNLOCK
VIRS
OUTPUTS
SUBCARRIER
COMP SYNC
COMP BLANKING
SPG1 NTSC
TEKTRONIX®
CONVERGENCE
LINEARITY
1410


SYNC GENERATOR
SYNCHRONIZATION
SUBCARRIER
BLACK BURST SIGNAL
INTERNAL
GEN LOCK/EXT
GEN LOCK
EXTERNAL
SYNC
SUB CARRIER
HORIZONTAL LOCK
SUBCARRIER
MONO-CHROME
SYNC
HORIZ DELAY
PHASE
HORIZ UNLOCK
VIRS
OUTPUTS
SUBCARRIER
COMP SYNC
COMP BLANKING
SPG2 NTSC
TEKTRONIX®
LINEARITY
1410

2104-00

PART I

OPERATORS INFORMATION

OPERATING INSTRUCTIONS

SAFETY SUMMARY

This manual contains safety information that the operator and service technician must follow to avoid hazardous voltages and to ensure safe operation of the instrument.

WARNING information is intended to protect the operator from hazardous voltages.

CAUTION information is intended to protect the instrument from damage.

The following are general safety precautions that must be observed during all phases of operation and maintenance.

WARNING

To reduce electrical shock hazard, the instrument must be properly grounded. Refer to the 1410 Mainframe manual for more information.

Electrical shock hazards are present inside the instrument. Only qualified service personnel should remove the instrument covers.

DESCRIPTION

The SPG1 and SPG2 NTSC Sync Generators are two-location wide generators of sync and timing signals for the 1410 and 1410 Option 1 NTSC Generator system. All the timing signals required for operation of any of the test signal generator modules in the 1410 system are available from the SPG1 and SPG2.

Parallel outputs of sync and blanking pulses are available at the SPG1 and SPG2 front panels and the 1410 rear panel. The generators also provide Black Burst outputs with the provision of the Vertical Interval Reference Signal (VIRS) on line 18 or 19, or full field.

The SPG1 and SPG2 can both be referenced to an external source of composite sync and subcarrier. The SPG2 can be Gen-Locked to an external composite video signal.

REMOTE OPERATION

Via the Remote connector on the rear panel of the host 1410 Mainframe, the SPG1 and SPG2 can be remotely commanded to change operating modes. Also, status of operating modes and external reference signals are provided as outputs capable of driving LED indicators.

Logic 'low' levels are required for the input switching functions.

Connect LED's between any of the output circuits and chassis ground as status indicators. See Table 1-1.

TABLE 1-1

1410 Remote Connector J41	SPG1 or SPG2 Function
Pin 25	Subcarrier Absent Output
Pin 26	In Internal Mode Output
Pin 27	Sync Absent Output
Pin 29	Internal Mode Input
Pin 30	External Mode Input
Pin 31	Genlock Mode Input
Pin 36	Chassis Ground

FRONT-PANEL CONTROLS (Refer to Figs. 1-1 and 1-2)

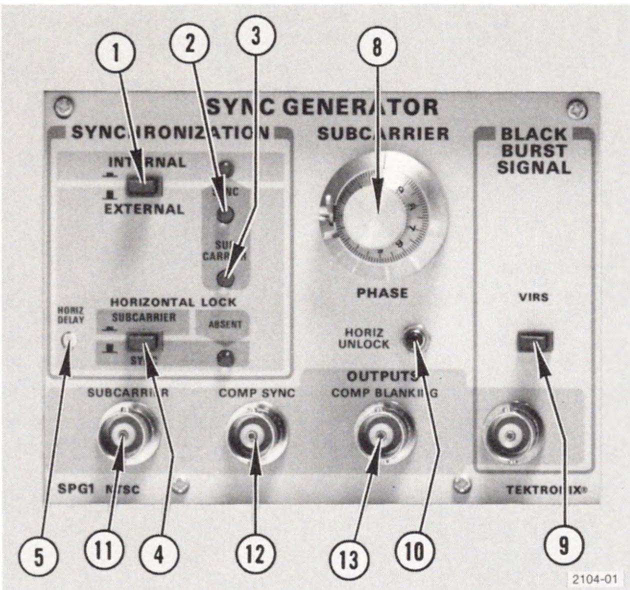


Fig. 1-1. SPG1 front-panel controls.

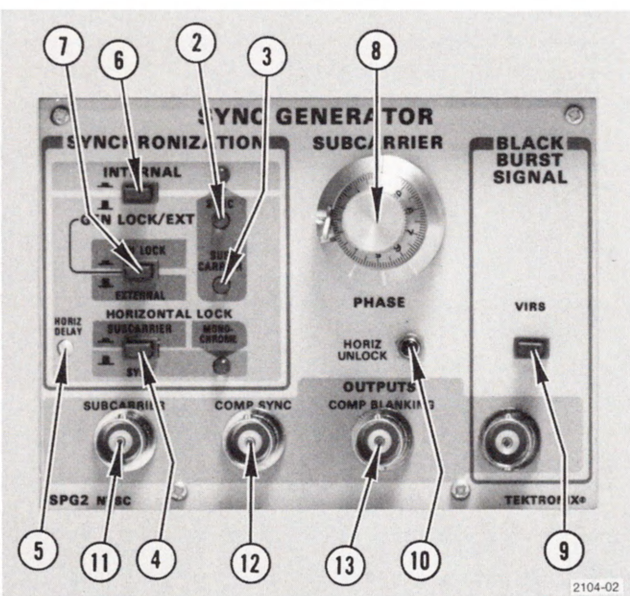


Fig. 1-2. SPG2 front-panel controls.

SYNCHRONIZATION

(1) INTERNAL-EXTERNAL—Selects INTERNAL reference (button pressed in), or external source of composite sync and subcarrier (button out). INTERNAL LED lights when INTERNAL reference is selected.

(2) SYNC—LED indicates absence of composite sync in EXTERNAL mode. Loss of incoming composite sync automatically causes the SPG1 to switch to internal sync reference or to full internal gen (determined by internal plug-jumper). If HORIZONTAL LOCK is in the SYNC mode, full internal gen is always selected when incoming sync is lost. The user can select (via internal plug-jumper) to cause loss of incoming sync to inhibit all signals. The SYNC LED may be lit or out at the user's discretion.

(3) SUBCARRIER—LED indicates absence of subcarrier in external mode. Loss of incoming subcarrier causes the SPG1 to automatically switch to full internal gen or lock to sync. The user can elect (via internal plug-jumper) to cause loss of incoming subcarrier to inhibit subcarrier on all signals. The SUBCARRIER LED may be lit or out at the user's discretion.

HORIZONTAL LOCK

(4) SUBCARRIER-SYNC—Selects either incoming subcarrier or composite sync to phase-lock the timing generator clock oscillator on sync timing board A20. The SPG1 automatically switches reference to incoming composite sync if subcarrier is absent and the SPG1 is not programmed to switch to full internal on loss of subcarrier, causing the SYNC LOCK LED to light. The SYNC LOCK indicator is lit if locked to sync.

(5) HORIZ DELAY—Delays the output sync $\pm 1/2\ \mu s$ with respect to external input sync. A wider range ($+4\ \mu s$, $-10\ \mu s$) can be selected via internal switch.

(6) INTERNAL-GEN LOCK/EXT—Selects INTERNAL reference (button pressed in) or external signal source (button out). The INTERNAL indicator is lit in the INTERNAL mode.

(7) GEN LOCK-EXTERNAL—In the GEN LOCK/EXT mode, the GEN LOCK-EXTERNAL switch selects either an external source of composite sync and subcarrier (EXTERNAL, button out) or an external source of composite video (GEN LOCK, button in). SYNC and SUBCARRIER indicators respond to loss of the corresponding signal or portion of the signal in both modes. The LED indicator may be lit or out for loss indication at the user's discretion. With signal loss, the SPG2 switches to internal sync reference or to full internal gen. If HORIZONTAL LOCK is in the SYNC mode, full internal gen is always selected when sync is lost. Loss of subcarrier switches the SPG2 to full internal gen or to sync lock.

(8) PHASE—Varies the phase of the subcarrier portion of the output signals, and the subcarrier signal at the rear-panel SUBCARRIER connector, 360° with respect to incoming subcarrier and subcarrier at the front-panel connector.

(9) VIRS On-Off (pressed in—VIRS on, released—VIRS off)—Selects the Vertical Interval Reference Signal (VIRS) on line 18 or 19 of either or both fields at the BLACK BURST SIG output connector.

(10) HORIZ UNLOCK—Momentary-closure pushbutton unlocks H sync from subcarrier. For testing subcarrier packet risetimes, etc.

CONNECTORS

(11) SUBCARRIER—2 V p-p of 3.579545 MHz subcarrier from the selected source (internal or external).

(12) COMP SYNC—4 V of negative-going composite sync.

(13) COMP BLANKING—4 V of negative-going composite blanking.

PERFORMANCE CHECK

This procedure is to be used to verify that the SPG1 or SPG2 is performing to specifications. None of the checks in this procedure involve any internal adjustments or operating changes. Do not remove the protective covers.

This procedure assumes no changes to factory-set operating modes.

Control and connector titles on the SPG1 or SPG2 are capitalized in this procedure, for example: HORIZ UNLOCK. Controls and connectors on test equipment or the 1410 Mainframe and any modules installed in the Mainframe have only their first letter capitalized, for example: Test Oscilloscope Time/Div, or 1410 rear-panel Gen Lock loop-through connector.

TEST EQUIPMENT

The test equipment listed here was used in preparing this procedure. The measurement capabilities described are the minimum required to verify instrument performance. Each piece of test equipment is assumed to be operating within its stated specifications. If alternative equipment is used, it must meet or exceed these requirements.

1. Test Oscilloscope

Dual Time Base. Range from 50 ns/Div to 5 s/Div with provisions for a delaying sweep and television triggering.

Differential Comparator. Bandwidth, dc to 30 MHz; minimum deflection factor, 1 mV/Div; two channels capable of differential operation.

Dual Trace Amplifier. Vertical amplifier independent of the Differential Comparator. Bandwidth, dc to 30 MHz; minimum deflection factor, 5 mV/Div) e.g., a Tektronix 7603 with 7B53A Option 5 Dual Time Base, 7A13 Differential Comparator, and 7A18 Dual Trace Amplifier.

2. Leveled Sine Wave Generator

Capable of amplitudes from 0.2 to 5 volts peak-to-peak; frequency range, from 50 kHz to 5 MHz (e.g., a Tektronix SG 503 in a TM 500-series Power Unit).

3. Return Loss Bridge

Tektronix Part No. 015-0149-00.

4. 50 Ω to 75 Ω Minimum Loss Attenuator

Tektronix Part No. 011-0057-00.

5. 75 Ω Feed-through Termination

Two, matched within 0.2%, supplied as accessories with the Return Loss Bridge (Item 3). Tektronix Part No. 011-0103-00 (red), and 011-0103-01 (green).

6. 75 Ω Feed-through Termination (2)

Tektronix Part No. 011-0103-02.

7. 75 Ω Cable (5)

42 inches long. Tektronix Part No. 012-0074-00.

8. A test signal generator module (TSG1, TSG2, TSG3, TSG4) mounted in the 1410 along with the SPG1 or SPG2. The test signal generator signal must contain a subcarrier portion at 0 APL with more than 19 cycles of subcarrier.

9. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal (e.g., a Tektronix 1410 with SPG1 or SPG2; or a Tektronix 146).

10. Waveform Monitor

Capable of overlaying one portion of a line sweep display on another portion and having sweep magnification to at least 0.1 μs/div (e.g., a Tektronix 1480-series).

11. Vectorscope

Capable of measuring phase differences between two signals of less than 0.5° (e.g., a Tektronix 520A).

12. Spectrum Analyzer

Capable of measuring the third harmonic of the color subcarrier to below −30 dB (e.g., a Tektronix 7L12 or 7L5/L2, 7000-series plug-in unit).

13. Frequency Counter

Capable of resolving 0.25 Hz out of 3 MHz, (e.g., a Hewlett-Packard 5326A Option 011).

14. Calibration Fixture

For use with the waveform Monitor. See Fig. 1-3.

EQUIPMENT SETUP

1. Test Oscilloscope

(7603 with the 7B53A Option 5 in the right compartment, the 7A18 in the left compartment, and the 7A13 in the center compartment.

7603

Power	On
Readout	
Intensity	Best Display
Grat Illum	
Focus	
Vert Mode	Left
Trig Source	Left

7A13

+ Input	DC
− Input	DC
Volts/Div	.1
Variable	Cal
BW	Full

7A18

Ch 1 and Ch 2	
Volts/Div	1
Variable	Cal
Coupling	DC
Trigger Source	Ch 1
Display Mode	Alt
Ch 2 Polarity	+ Up

7B53A

Main Triggering	
Mode	Auto
Coupling	AC
Source	Int
Time/Div	10 μs
Variable	Cal
Mag	X1

2. 1410 with SPG1 or SPG2 and Test Signal Module

1410

Power	On
Test Signal Module	Set for signal containing subcarrier at 0 APL

SPG1

INTERNAL-EXTERNAL	EXTERNAL
HORIZONTAL LOCK	SUBCARRIER
BLACK BURST SIG VIRS	ON

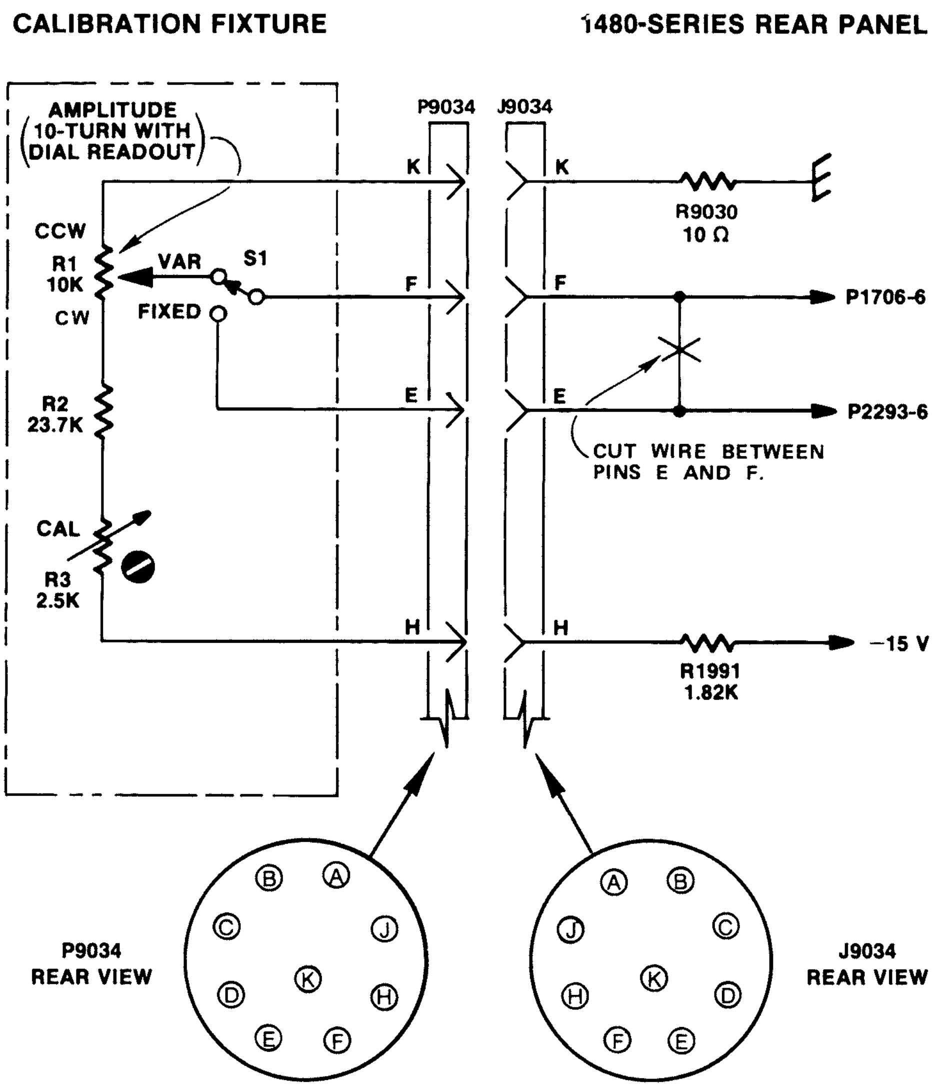
SPG2

INTERNAL-GEN LOCK/EXT	GEN LOCK/EXT
GEN LOCK-EXTERNAL	EXTERNAL
HORIZONTAL LOCK	SUBCARRIER
BLACK BURST SIG VIRS	ON

PROCEDURE

1. Check HORIZ DELAY Range

a. Display composite video from the Video Signal Source and from the 1410 Test Signal Module simultaneously on the Test Oscilloscope. Externally trigger the Test Oscilloscope with the composite from the Video Signal Source.



Parts List

Ckt No.	Description	Tektronix Part No.
P9034	9-pin Amphenol #165-13	134-0049-00
R1	10kΩ ±5%, Ind. Lin. ±0.1%, 10-turn, prec. var.	311-1729-00
R2	23.7 kΩ ±1%, 1/8 W, metal film	321-0325-00
R3	2.5 kΩ ±20%, variable	311-0086-00
S1	SPDT toggle switch	260-0613-00
	10-turn dial for R1, Kilo-dial Mod. 461-S-41	331-0139-00
Misc.	Approx. 3 ft. of 4-conductor cable and a small metal or plastic enclosure or case.	

Set R1 fully counterclockwise (ccw) and the dial at 0 when installing the dial.

2329-04

Fig. 1-3. Waveform Monitor Calibration Fixture.

b. Check—The leading edges of the two displayed line sync pulses should coincide.

c. Adjust—HORIZ DELAY (R175) until the sync pulses leading edges coincide.

2. Check Vertical Phasing

a. Set the Test Oscilloscope Dual Time Base Time/Div to 2 ms. Use the delaying sweep to view the vertical intervals of the two signals.

b. Check—The two displayed signals should coincide.

3. Check Field Blanking Duration (Variable)

a. Display the SPG1 or SPG2 COMP BLANKING output and composite video from the Video Signal Source simultaneously on the Test Oscilloscope.

b. Set the Test Oscilloscope Time/Div and Delayed Sweep Time/Div to view the vertical interval.

c. Check—The duration of the field blanking pulse should be 20 lines.

4. Check Line Blanking Duration (Variable)

a. Display signals from the SPG1 or SPG2 front-panel COMP BLANKING connector and the 1410 rear-panel H Drive connector simultaneously on the Test Oscilloscope.

b. Set the Test Oscilloscope Time/Div to display a horizontal line.

c. Check—Fixed line blanking duration should be 10.7 μs as measured at the 50% amplitude point on the signal.

5. Check Burst Delay and Burst Width

a. Display the SPG1 or SPG2 BLACK BURST and SUBCARRIER signals simultaneously on the Test Oscilloscope.

b. Using the Test Oscilloscope delayed sweep function, view the line sync area with the main sweep at a field rate and the delayed sweep at about 2 μs.

c. Check—The time between the leading edge of line sync and the start of burst (50% points from the blanking level) should be equal to the duration of 19 cycles of subcarrier.

d. Check—Burst width should be 9 cycles of subcarrier.

e. CHECK—The breezeway should be approximately 600 ns in width, as measured from the 50% point of the trailing edge of sync to the zero crossing preceding the 50% amplitude point of burst with respect to blanking.

f. Check—The front porch should be 1.4 μs in width as measured at the 50% amplitude points on sync and setup with respect to blanking.

6. Check Sync Timing

a. Display the SPG1 or SPG2 COMP SYNC signal on the Test Oscilloscope.

b. Using the Test Oscilloscope delayed sweep function, view the vertical interval area of the signal.

c. Check—Sync timing as follows:

Line sync duration	4.70 μs ±100 ns	measured at 50% points
Equalizing pulse duration	2.3 μs ±100 ns	measured at 50% points
Interval between sync pulses	4.77 μs ±100 ns	measured at 50% points
Field sync pulse	6 equalizing pulses—6 sync pulses—6 equalizing pulses	

7. Check SCH φ Center

a. Display a composite video signal from the Video Signal Source on the Waveform Monitor. The displayed signal must contain at least 19 cycles of subcarrier on the 0 APL level.

b. Set the Waveform Monitor Field switch to 1, Display to 10 μs/Div, Line Selector to Digital and Line 17, and Sync to External and Direct.

c. Externally trigger the Waveform Monitor with comp sync from the Video Signal Source.

d. Using the Waveform Monitor Waveform Comparison controls, overlay the second line sync pulse on the first line subcarrier.

e. Using the Waveform Monitor Vertical Position control, place the 50% amplitude point of the sync pulse on a reference line.

f. Rotate the Video Signal Source Subcarrier Phase control to place the zero crossing point of the positive-going slope of a cycle of subcarrier on the reference line.

g. Display the Waveform Monitor Line Strobe Out and the Field Ref signal from the 1410 rear panel simultaneously on the Test Oscilloscope.

h. Check—The two pulses displayed on the Test Oscilloscope should be field coincident.

i. Check—The Field Ref signal from the 1410 rear panel should shift one frame in time with each rotation of the Video Signal Source Subcarrier Phase control.

8. Check Subcarrier To Sync Lock Timing

a. Display the SPG1 or SPG2 BLACK BURST signal on the Test Oscilloscope. The SPG1 or SPG2 should still be in an external lock mode.

b. Externally trigger the Test Oscilloscope from the Video Signal Source.

c. Check—The display shift should be less than 100 ns as the HORIZONTAL LOCK is switched between SUBCARRIER and SYNC.

d. Set the SPG1 or SPG2 to INTERNAL.

e. Trigger the Test Oscilloscope internally.

f. Press the SPG1 or SPG2 front-panel HORIZ UNLOCK button.

g. Check—The subcarrier portion of the displayed signal should free run.

9. Check INTERNAL Mode Operation

a. Connect composite sync, subcarrier, and composite video from the Video Signal Source to the appropriate 1410 rear-panel loop-through connectors.

b. Set the SPG1 or SPG2 for INTERNAL operation.

c. Display the SPG1 or SPG2 BLACK BURST signal and a signal from the Video Signal Source simultaneously on the Test Oscilloscope. Trigger the Test Oscilloscope externally from the Video Signal Source.

d. Check—The front-panel INTERNAL LED should be lit and the two signals displayed on the Test Oscilloscope should not be locked.

10. Check SYNC Lock EXTERNAL Mode Operation

a. Set the SPG1 or SPG2 for EXTERNAL operation. Set the HORIZONTAL LOCK Switch to SUBCARRIER.

b. Check—The SYNC and SUBCARRIER LED's indicate the presence of external sync and subcarrier.

c. Check—The two signals displayed on the Test Oscilloscope should be locked.

d. Remove composite sync from the 1410 rear-panel loop-through connector.

e. Check—The SYNC LED should change states and the two signals displayed on the Test Oscilloscope should remain locked.

f. Release HORIZONTAL LOCK switch.

g. Check—SYNC LOCK and INTERNAL LED's should light and the two signals displayed on the Test Oscilloscope should not be locked.

h. Connect composite sync to the appropriate 1410 rear-panel loop-through connector.

11. Check—SUBCARRIER Lock EXTERNAL Mode Operation

a. Set the SPG1 or SPG2 HORIZONTAL LOCK to SUBCARRIER.

b. Remove the subcarrier signal from the 1410 rear-panel loop-through connector.

c. Check—The SUBCARRIER LED should indicate the absence of external subcarrier, the SYNC LOCK LED should be lit, and the two signals displayed on the Test Oscilloscope should remain locked.

d. Connect subcarrier to the 1410 rear-panel loop-through connector.

12. Check GEN LOCK Mode (SPG2 only)

a. Set the SPG2 for GEN LOCK operation.

b. Remove composite sync from the Video Signal Source composite video signal.

c. Check—The SYNC and SUBCARRIER LED's should change states and the INTERNAL LED should be lit.

d. Restore composite sync to the Video Signal Source composite video signal.

e. Remove burst from the Video Signal Source composite video signal.

f. Check—The SUBCARRIER LED should change states and the SYNC LOCK LED should be lit.

g. Restore burst to the Video Signal Source composite video.

13. Check Subcarrier Phase

a. Connect the SPG2 BLACK BURST signal to the Vectorscope.

b. Lock the Vectorscope to the Video Signal Source subcarrier.

c. Check—The burst phase displayed on the Vectorscope should not vary more than ±3° as the input signal amplitude is varied from one-half to two times nominal (1 V).

14. Check Phase Stability with Dynamic APL

a. Apply a composite video signal that is variable in Average Picture Level from the Video Signal Source to the 1410 rear-panel Gen Lock loop-through input.

b. Check—The phase of the signal displayed on the Vectorscope should change by 0.1° or less as the input APL is varied from 10% to 90%.

15. Check SUBCARRIER PHASE Range

a. Rotate the SPG2 SUBCARRIER PHASE control.

b. Check—The phase of the signal displayed on the Vectorscope should change 360° for each 360° rotation of the SUBCARRIER phase control.

16. Check Horizontal Jitter

a. Display the SPG2 BLACK BURST signal on the Test Oscilloscope.

b. Externally trigger the Test Oscilloscope with composite sync from the Video Signal Source.

c. Using the Test Oscilloscope delayed sweep function and magnifier, view the leading edge of a line sync pulse at 20 ns/div (.2 μs/div x 10 mag).

d. Check—With the SPG2 HORIZONTAL LOCK in SYNC, jitter on the sync pulse leading edge should be 10 ns or less. With HORIZONTAL LOCK in SUBCARRIER, jitter should not exceed 4 ns.

17. Check Oscillator Frequency

NOTE

After inital shipment or long storage, allow approximately 2-hour warm-up period to re-age the crystal. Thereafter, 10 to 20 minutes warm-up is sufficient.

a. Remove the composite video signal from the 1410 rear-panel Gen Lock loop-through connector.

b. Connect the SPG2 SUBCARRIER output to the Frequency Counter.

c. Check—Subcarrier frequency should be within 10 Hz of 3.579545 MHz if the SPG2 is installed in a 1410, or within 1 Hz of 3.579545 MHz if the SPG2 is installed in a 1410 Option 1.

18. Check Subcarrier Amplitude

a. Connect one of the 1410 rear-panel Subcarrier outputs through 75 Ω termination to the Test Oscilloscope input.

b. Check—The Subcarrier signal should be 1.8 volts peak-to-peak to 2.2 volts peak-to-peak in amplitude.

c. Check—The other 1410 rear-panel Subcarrier output should be as in step b.

d. Connect the SPG1 or SPG2 SUBCARRIER output through 75 Ω termination to the Test Oscilloscope input.

NOTE

The SPG1 or SPG2 SUBCARRIER output is driven directly from the Subcarrier Output Amplifier on the 1410 Subcarrier Input board, A13. This output is provided as a subcarrier phase reference. The subcarrier signal phase at the SPG1 or SPG2 front panel cannot be varied with the SUBCARRIER PHASE control, but is always the same as the reference subcarrier (either from the 1410 Subcarrier Oscillator or from an external source).

e. Check—The SUBCARRIER signal amplitude should be 1.8 volts peak-to-peak to 2.2 volts peak-to-peak.

19. Check Comp Blanking Compensation

a. Connect the SPG1 or SPG2 COMP BLANKING output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Risetime and falltime should each be 120 ns to 160 ns.

d. Repeat this step for each of the two 1410 rear-panel Comp Blanking outputs.

20. Check Comp Sync Compensation

a. Connect the SPG1 or SPG2 COMP SYNC output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Risetime and falltime should each be 120 ns to 160 ns.

d. Repeat this step for each of the two 1410 rear-panel Comp Sync outputs.

21. Check Burst Flag Compensation, Burst Flag Delay, and Burst Flag Width

a. Connect the 1410 rear-panel Burst Flag output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Risetime and falltime should each be 120 ns to 160 ns.

d. Externally trigger the Test Oscilloscope with the SPG1 or SPG2 COMP SYNC signal.

e. Connect one of the 1410 rear-panel Comp Sync outputs through 75 Ω termination to the Test Oscilloscope so that comp sync and burst flag are displayed simultaneously.

f. Note the position of the leading edge of line sync.

g. Check—The leading edge of the Burst Flag pulse should be 5.3 μs ±35 ns from the leading edge of line sync.

h. Check—The half-amplitude width of the Burst Flag pulse should be 2.5 μs ±70 ns.

22. Check H Drive Compensation

a. Connect 1410 rear-panel H Drive output J16 through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Risetime and falltime should each be 120 ns to 160 ns.

d. Repeat this step for H Drive output J15 on the 1410 rear panel.

23. Check V Drive Compensation

a. Connect 1410 rear-panel V Drive output J18 through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Risetime and falltime should be 120 ns to 160 ns.

d. Repeat this step for V Drive output J19 on the 1410 rear panel.

24. Check Field Reference Compensation

a. Connect the 1410 rear-panel Field Ref output J14 through 75 Ω termination to the Test Oscilloscope input.

b. Connect the SPG1 or SPG2 BLACK BURST signal through 75 Ω termination to the other Test Oscilloscope input.

c. Externally trigger the Test Oscilloscope with V Drive from the 1410 rear panel.

d. Check—The Field Reference signal amplitude should be 3.8 volts to 4.2 volts.

NOTE

The Field Reference pulse is on either Field 1, line 11, or Field 3, line 10.

e. Check—Risetime and falltime should each be 120 ns to 160 ns.

25. Check VIRS Amplitude

a. Connect the Black Burst output connector to the 1480 Ch A input and terminate in 75 Ω. Set the VIRS pushbutton in the on position.

NOTE

If the SPG1 or SPG2 is internally set for full field reference, do not use the 1480 Line Selector function. If the VIRS is not set for full field, use the 1480 Line Selector to find the VIRS on line 18 or line 19.

b. Set the 1480 display to 10 μs/div, Volts Full Scale to 0.5, and push in the Cal and Oper switches.

c. Check—Using the Amplitude dial of the Calibration Fixture to match the sync tip with blanking, read 286 mV ±3.6 mV.

26. Check DC Level

a. Set the 1480 Volts Full Scale to 1.0, Display to 10 μs/div, push in the Oper switch, set the DC Restorer Off and Response switch to Aux Video In. Position the trace to the 0 IRE graticule line and change the Black Burst output cable to the Aux Video In connector.

b. Check—The waveform blanking level should be 0 V ±50 mV (±7 IRE).

c. Return the Black Burst output cable to the 1480 Ch A input connector.

27. Check VIRS Luminance Levels

a. Check—Use the Calibration Fixture to read the following:

Setup Level—53.57 mV ±3.57 mV
Gray Level—357 mV ±3.57 mV
Chrominance Pedestal—500 mV ±5 mV

28. Check VIRS Luminance Risetime

a. Set the 1480 to measure risetime—Mag at .1 μs/div.

b. Check—Luminance risetime should be 250 ns ±37.5 ns.

Graticule A has built-in risetime and falltime measurement capability. Point R at 80 IRE Units aligns with T on the 0 IRE Unit reference line.

To measure risetime or falltime, set the transition amplitude to 100 IRE Units (use the VARiable Volts Full Scale). Vertically position the display so that the transition is from the −10 IRE Units line to the +90 IRE Units line. Use the 100 ns/div time base and horizontally position the rise (or fall) of the transition through point R on the short 2 IRE Unit/div scale. Measure the distance from point T on the 0 IRE Unit reference line to where the transition crosses the reference line.

29. Check Sync Risetime

a. Check—Sync risetime should be 130 ns +20 ns −10 ns.

30. Check Burst Risetime

a. Push in the HORIZ UNLOCK pushbutton on the SPG front panel. Push in the INTERNAL/EXTERNAL pushbutton.

b. Check—Burst risetime should be 400 ns ±60 ns.

31. Check VIRS Chrominance Risetime

a. Push in the HORIZ UNLOCK pushbutton on the SPG front panel.

b. Check—Chrominance risetime should be 1 μs ±150 ns.

c. Release the SPG HORIZ UNLOCK button.

32. Check Chrominance Bandpass Filter

a. Connect the Black Burst output to the Spectrum Analyzer and display the chrominance signal.

b. Check—Third order harmonics should be −30 dB.

33. Check Residual Subcarrier

a. Set the 1480 VFS to 0.2 and position the blanking level at the 0 IRE graticule line.

b. Check—Residual subcarrier should be 2.5 mV or less.

34. Check Chrominance Amplitude

a. Set the 1480 to Cal mode. Use the Calibration Fixture Amplitude control to position the top and bottom of the chrominance packet to the blanking level. Subtract the two readings to obtain the actual amplitude.

b. Check—Chrominance amplitude should be 285.7 mV ±2.86 mV and the bottom of the chrominance packet should be even with the gray level.

35. Check Black Burst Setup Level

a. Display the Black Burst signal on the 1480.

b. Check—Setup level should be 53.57 mV ±3.57 mV.

36. Check Black Burst Timing

a. Check—Refer to Fig. 1-4 for timing details.

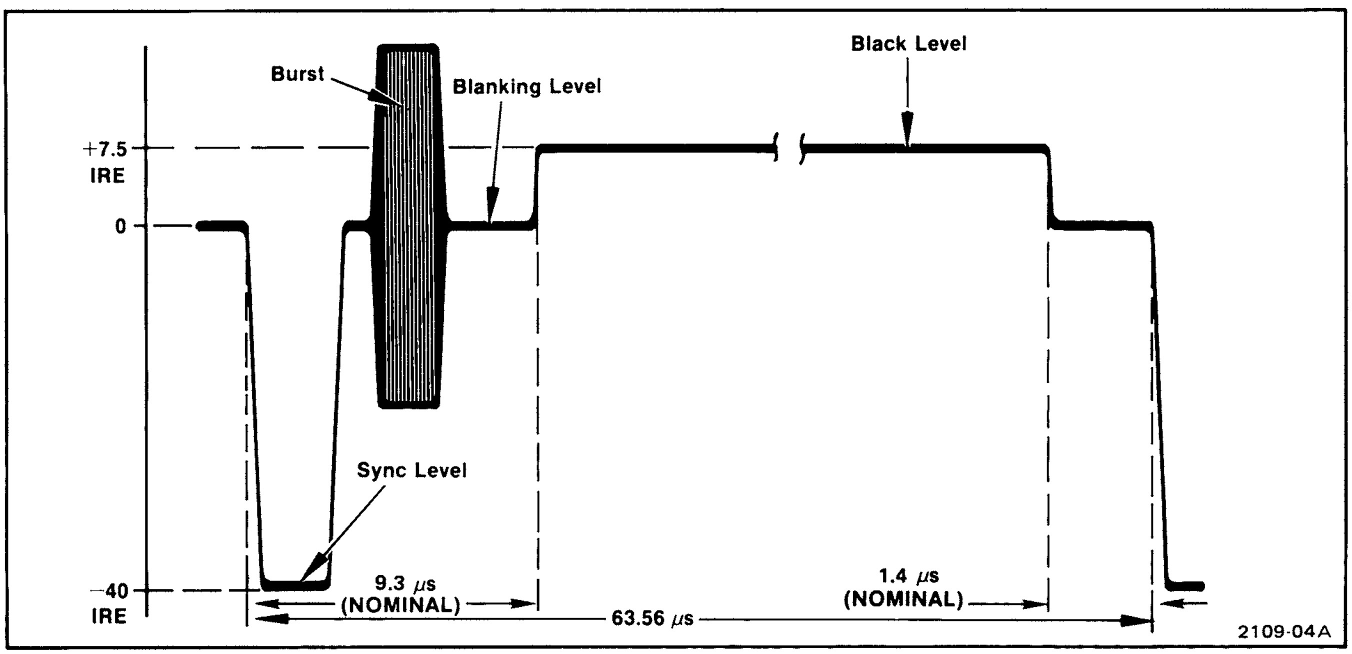


Fig. 1-4. Black Burst timing details.

37. Check Subcarrier Phase

a. Connect the 1410 Mainframe subcarrier output to the vectorscope CW Ext ϕ Ref input. Connect the other Ext ϕ Ref input to Ch B through the 10X attenuator pad. Connect the BLACK BURST output to Ch A. Display Ch A and Ch B.

b. Use the Vectorscope Line Selector to display the VIRS if not in full field mode.

c. Check—VIRS subcarrier phase is within 0.5° of the SPG1 or SPG2 burst phase.

38. Check VIRS Timing

a. Display the VIRS on the 1480.

b. Check—Refer to Fig. 1-5 (in the Operating Instructions section) for timing details.

39. Check Return Loss

a. Remove all connections from the SPG1 or SPG2, the 1410, and the Test Oscilloscope.

b. Set the SPG1 or SPG2 for INTERNAL operation.

c. Trigger the Test Oscilloscope internally.

d. Connect the Return Loss Bridge to the Test Oscilloscope Differential Comparator.

e. Connect the Leveled Sine Wave Generator through 50 Ω to 75 Ω Minimum Loss Attenuator to the Return Loss Bridge input.

f. Set the Leveled Sine Wave Generator Frequency Range to Ref (5 MHz), and the Test Oscilloscope Volts/Div to .1 V. Set the Differential Comparator for differential operation.

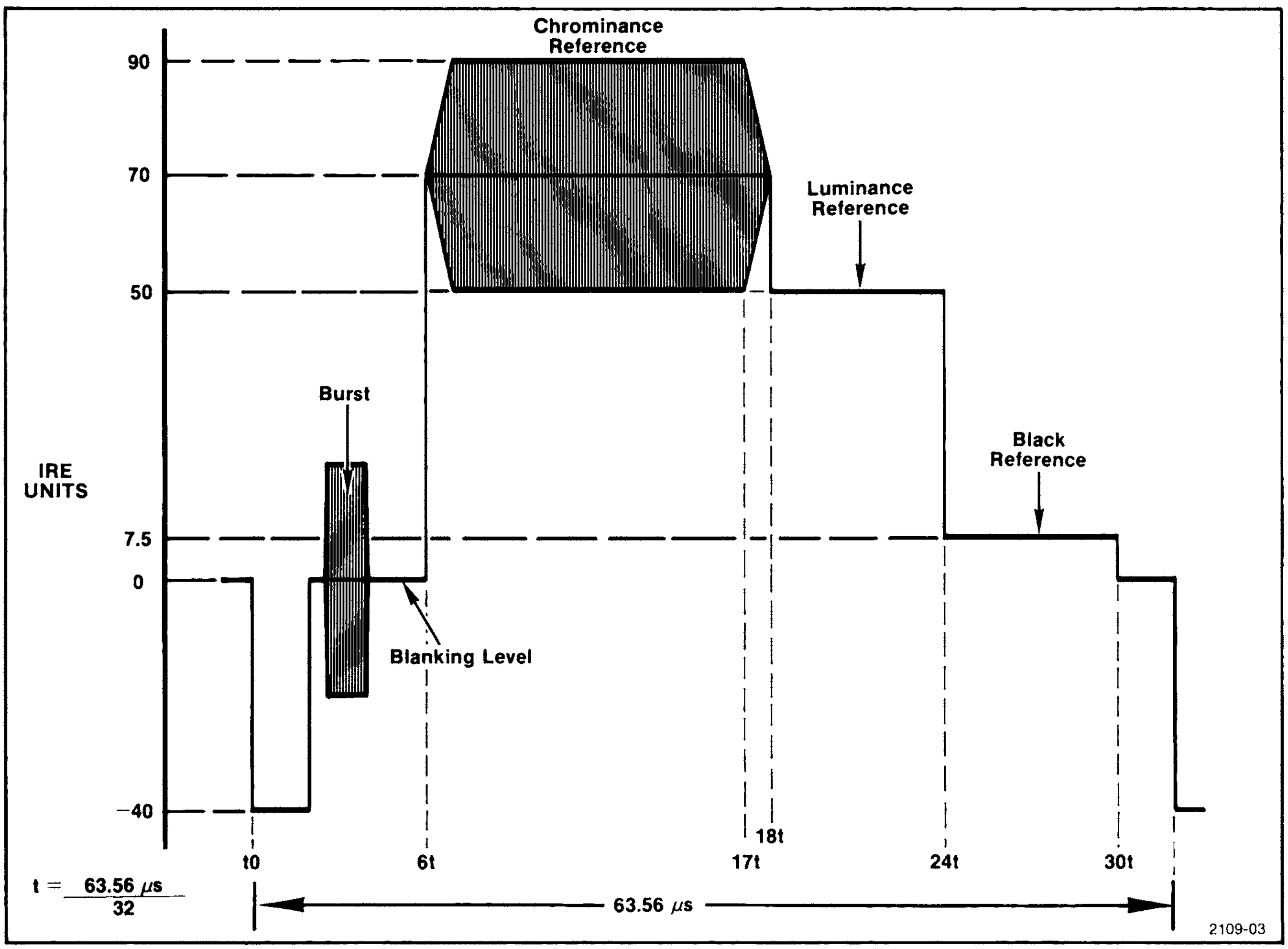


Fig. 1-5. VIRS timing details.

g. Remove the 75 Ω termination from the Return Loss Bridge Unknown arm and adjust the Leveled Sine Wave Generator Output Amplitude control for 500 mV display amplitude.

h. Replace the 75 Ω termination on the Return Loss Bridge Unknown arm.

i. Set the Test Oscilloscope Volts/Div to 10 mV.

j. Adjust the Return Loss Bridge Balance control for minimum display amplitude.

k. Remove the 75 Ω termination from the Return Loss Bridge Unknown arm.

l. Check return loss of all outputs on the SPG1 or SPG2 front panel and the 1410 rear panel (except SUBCARRIER) by connecting the unterminated Unknown arm to each connector and checking the Test Oscilloscope display amplitude for 16 mV or less.

m. Check return loss of the loop-through inputs on the 1410 rear panel by connecting the Unknown arm to one side of the loop-through connector and the 75 Ω termination to the other side. Check for 3 mV display amplitude.

n. Remove the Return Loss Bridge.

40. Check Isolation

a. Check all double and triple outputs for active and passive isolation in the following manner:

Passive Isolation. Connect the output of interest through 75 Ω termination to the Test Oscilloscope input. Observe the signal amplitude at that output while shorting another output of the same signal to ground. The observed signal amplitude should change by no more than 1%.

Active Isolation. Observe the output of interest on the Test Oscilloscope while introducing a subcarrier signal into another output of the same signal. The subcarrier signal should be attenuated at the observed output by at least 40 dB. The introduced subcarrier signal amplitude should be varied from 0.5 to 4.0 volts.

SPECIFICATIONS

ELECTRICAL CHARACTERISTICS

The performance requirements listed here apply over an ambient temperature range of 0°C to +50°C. The rated accuracies are valid when the instrument is calibrated at +20°C to +30°C with ten minutes warm-up time. A twenty minute warm-up is required for rated accuracies 0°C ambient temperature.

Characteristics	Performance Requirements	
	SPG1	SPG2 Only
GEN LOCK	Does Not Apply	
Input Configuration		75 Ω loop-through
Input Requirements		
Sync Source		1 V nominal composite video or black burst, sync negative.
Sync Amplitude		286 mV ±6 dB.
Burst Amplitude		286 mV ±12 dB.
Burst/Sync Ratio		Within 6 dB.
Return Loss		⩾−46 dB to 5 MHz.
Loss of Lock		Indicated by front-panel LED's (automatic switching to full or partial internal).
Gen-Locked Subcarrier		
Phase error with Frequency Change		Within 0.5° with input burst frequency change of ±10 Hz.
Phase Error with Temperature Change (input burst within 10 Hz of nominal, oven temperature in normal range).		Within 5° with ambient temperature change from 0°C to 50°C, within 1° for any 10°C increment from 0°C to 50°C.
Phase Error with Burst Amplitude Change (input burst frequency within 10 Hz of nominal, oven temperature in normal range, ambient temperature +20°C).		±1° with amplitude change from 210 mV to 420 mV, ±3° with amplitude range from 75 mV to 1.2 V.
Phase Stability (Breezeway Effect)		0.2° for burst timing errors including burst width variance (8 to 10 cycles) and breezeway variance (+0.28 μs).
Phase Stability with Dynamic APL		0.1° or less with APL change from 10% to 90%.
Phase Stability with Noise		Within 1° with rms white noise at 24 dB below nominal p-p picture signal (nominal 714 mV).
Chroma Phase Range		360° via front-panel goniometer.
Line Sync Delay Range		Internal switch sets delay range to +10 μs, −4 μs. Front panel range ±1/2 μs.

Characteristics	Performance Requirements
	SPG1 EXT—SPG2 GEN LOCK & EXT
Stability (over ambient temperature range 0° C to 50° C).	
Subcarrier to Sync Lock Timing	Adjustable, range: +2 lines, −3 lines. Adjusted for 0 lines error.
Line Lock	Within 70 ns.
Subcarrier Lock	Within 35 ns.
Horiz Jitter	
Line Lock	10 ns or less.
Subcarrier Lock	4 ns or less.
Field/Frame Sync	Fast Lock: Direct-acting in 1 field. 1 line time offset provided. Slow Lock: 1 line/field slew.

(Remainder of specifications common to SPG1 and SPG2)

EXTERNAL Reference	
Input Configuration	75 Ω loop-through.
Input Requirements	
SUBCARRIER INPUT	
Amplitude	1.0 V to 4.0 V p-p.
Frequency	3.579545 MHz ±10 Hz.
Return Loss	≥−46 dB to 3.579545 MHz.
COMP SYNC INPUT	
Amplitude	2.0 V to 8.0 V p-p.
Polarity	Negative-going.
Return Loss	≥−46 dB to 5 MHz.
Loss of Lock	Indicated by front-panel LED indicators. Automatic switching to partial or full internal reference.
Subcarrier Stability	Output follows input.
Line Sync Delay Range	Internal switch sets delay range to +10 μs, −4 μs. Front Panel Range ±1/2 μs.
Chroma Phase Range	360° via front-panel goniometer.
SYNC GENERATOR	
COMP SYNC	
Timing	
Equalizing Pulse	2.3 μs ±100 ns.
Duration	Measured at 50% points.
Equalizing Pulse	3 lines
Sequence Duration	
Field Sync Duration	27.0 μs ±200 ns. Measured at 50% points.

Characteristics	Performance Requirements
SYNC GENERATOR (cont)	
Field Sync Pulse	
Sequence	6-6-6
Duration	3 lines.
Interval Between Field Sync Pulses	4.77 μs ±100 ns. Measured at 50% points.
Jitter	4 ns or less.
Line Sync Period	$\frac{1}{\frac{\text{subcarrier X2}}{455}}$
Line Sync Duration	4.70 μs ±100 ns at 50% point. 4.8 μs at 10% point.
COMP BLANKING	
Line Blanking Duration	10.7 μs nominal, adjustable 9 to 12 μs. Measured at 50% points.
Field Blanking Duration	20 lines nominal, adjustable 16 to 21 lines.
BURST FLAG	
Delay From Line Sync	Adjustable.
Duration	2.51 μs ±50 ns (9 cycles of subcarrier, adjustable).
LINE DRIVE	
Duration	Start of line blanking to end of line sync ±100 ns.
FIELD DRIVE	
Duration	9 lines.
FIELD REFERENCE	
Position	Field 1, line 11 or Field 3, line 10.
VIRS	
Chrominance	
Amplitude	285.7 mV ±2.86 mV (40 IRE ±0.4 IRE).
Phase	Within 0.5° of burst.
Envelope Risetime	Sin^2 shaped, 1 μs ±150 ns.
Luminance	
Setup Level	53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE).
Gray Level	357 mV ±3.57 mV (50 IRE ±0.5 IRE).
Chroma Pedestal	500 mV ±5 mV (70 IRE ±0.7 IRE).
Rise and Fall Time	Sin^2 Shaped, 250 ns ±37.5 ns (±15%).
Timing	See Fig. 2-1.

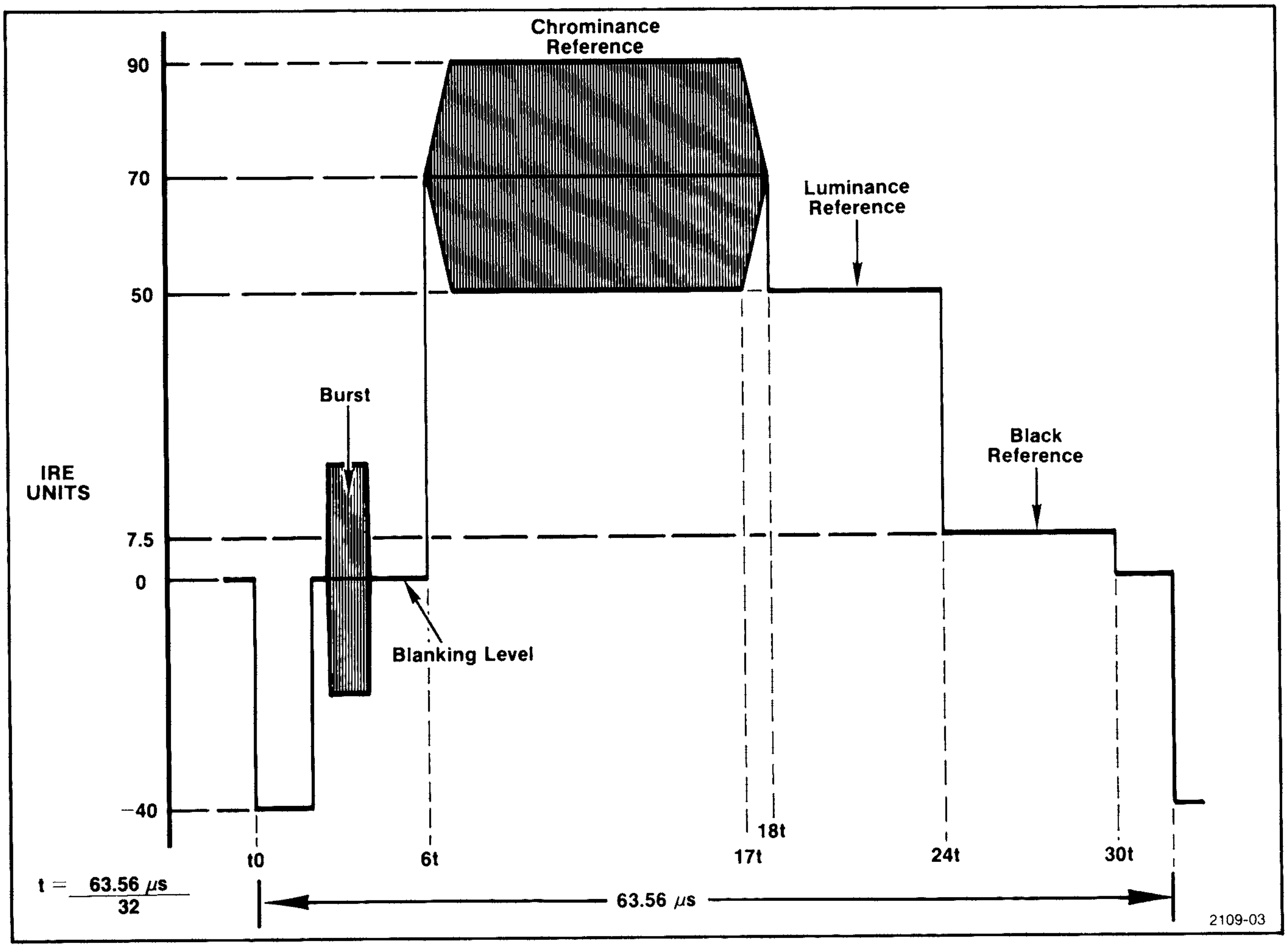


Fig. 2-1. VIR signal details.

Characteristics	Performance Requirements
VIRS (cont)	
Black Burst	
Amplitude	
Sync	286 mV ±3.57 mV (40 IRE ±0.5 IRE) negative-going.
Setup	53.57 mV ±3.57 mV (7.5 IRE ±0.5 IRE).
Sync & Setup Risetime	Sin^2 Shaped, 130 ns +20 ns, −10 ns.
Burst	286 mV ±2.86 mV (40 IRE ±0.4 IRE).
Timing	
Line Sync	4.70 μs ±100 ns at 50% point, 4.8 μs ±100 ns at 10%.
Period	63.56 μs (digitally determined from 3.579545 MHz).
Return Loss	At least 30 dB to 5 MHz.

Characteristics	Performance Requirements
VIRS (cont)	
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 40 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Field Sync	
Sequence	3 lines (digitally determined from 3.579545 MHz).
Interval between Field Sync Pulses	4.77 μs ±100 ns. Measured at 50% points.
Period	262.5 lines (digitally determined from 3.579545 MHz).
Equalizing Pulses	
Duration	2.33 μs ±50 ns at 50% points.
Sequence	3 lines (digitally determined from 3.579545 MHz).
Burst	
Delay from Line Sync	5.309 μs (19 cycles of subcarrier) ±35 ns.
H.A.D. of Envelope	2.51 μs (9 cycles of subcarrier) ±70 ns.
Rise and Fall Time	400 ns ±60 ns.
Breezeway	600 ns typical, from 50% point of line sync trailing edge to start of burst
Setup	Start 9.58 μs after leading edge of line sync, stop 1.59 μs before line sync leading edge.
PULSE OUTPUTS	
COMP SYNC	
Output Level into 75 Ω	4 V ±5%.
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.
COMP BLANKING	
Output Level into 75 Ω	4 V ±5%.
Return Loss	At least 30 dB to 5 MHz.

Characteristics	Performance Requirements
COMP BLANKING (cont)	
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.
BURST FLAG	
Output Level into 75 Ω	4 V ±5%
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.
LINE DRIVE	
Output Level into 75 Ω	4 V ±5%.
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.
FIELD DRIVE	
Output Level into 75 Ω	4 V ±5%.
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.

Characteristics	Performance Requirements
FIELD REFERENCE	
Output Level into 75 Ω	4 V ±5%.
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.
Rise and Fall Time	Linear ramp, 10% to 90% time 140 ns ±20 ns.
SUBCARRIER	
Amplitude into 75 Ω	2 V p-p ±10%.
Return Loss	At least 30 dB to 5 MHz.
Isolation	
Passive	Either open or short of one output shall cause an output level change at the other connector of 1% or less (40 dB) for all components of the signal.
Active (Non-Coherent Crosstalk)	A signal introduced to one output connector shall be attenuated by at least 30 dB at the other connector for signals between 0.5 and 4.0 volts in amplitude at or below color subcarrier frequency.

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Performance Requirements
Temperature	
Operating	0° C to 50° C.
Storage	−40° C to +65° C.
Altitude	
Operating	To 15,000 feet.
Storage	To 50,000 feet.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

PART II

SERVICE INFORMATION

INSTALLATION

INSTALLATION IN MAINFRAME

Use the following steps to install the SPG1 or SPG2 in the 1410 Generator mainframe. Turn the 1410 Power switch off and remove the power cord before installation. Refer to Fig. 3-1 as installation is performed.

1. The rows of pins on the 1410 Interface board are labeled beginning with P51 on the front left of the board. Note that, unlike the test signal modules, which can be placed in any location, the SPG1 or SPG2 must be installed in the two locations immediately to the right of the 1410 front panel.

Starting with row P51, install the boards in the following order:

P51 Pulse Output Amplifier A24
P52 Sync Lock A21
P53 Generator Logic A22
P54 Sync Timing A20
P56 Subcarrier Lock A23 (SPG2 only)
P57 VIRS/Black Burst A25

Position each board over the Interconnect pins using the plastic guides for pin alignment. Seat the board firmly on the Interconnect board.

2. Install shields (A100) as follows: Between rows P54 and P55 (separating Sync Timing A20 and Subcarrier Lock A23 in the SPG2 or VIRS/Black Burst A25 in the SPG1); between rows P56 and P57 in the SPG2 (separating Subcarrier Lock A23 from VIRS/Black Burst A25); and to the right of VIRS/Black Burst A25 (separating the SPG1 or SPG2 from the other modules).

3. Install plastic pushbutton extenders on pushbutton shafts.

4. Position the front panel over the pushbutton extenders and secure to the 1410 front casting with the screws provided.

5. Connect cables to the various boards as follows:

To	From
P816 A24	P76 1410 Rear Interconnect A5 and P75 1410 Rear Interconnect A5
P846 A24	P66 1410 Rear Interconnect A5 and P65 1410 Rear Interconnect A5
P759 A24	P339 A21 and Front Output Connectors
P755 A24	Front-Panel Goniometer
P339 A21	P759 A24 and P413 1410 Subcarrier Input A13
P743 A23	P98 1410 Rear Interconnect A5
P642 A23	P415 1410 Subcarrier Input A13
P996 A25	P58 1410 Rear Interconnect A5 and Front-Panel Output Connectors
P445 A22	P98 1410 Rear Interconnect A5
P449 A22	J41 1410 Remote Connector
P161, Pin 2, A20	P170, Pin 1, A21

Reverse the installation steps to remove the module.

OPERATING MODE SELECTION

A20 Sync Timing

P103 H Drive Start	Selects either fixed H Drive Start or variable H DRIVE Start. Variable Start varies with adustment of H Blanking Start, R116. P103 is factory-set to pins 1 and 2 variable.
S109 Horiz Phasing	Provides 4 μs delay to 10 μs adance with respect to external sync.
P110 Horiz Blanking	Selects either fixed or variable H Blanking width. R115 and R116 adjust starting and ending time. P110 is factory-set to pins 2 and 3, variable.

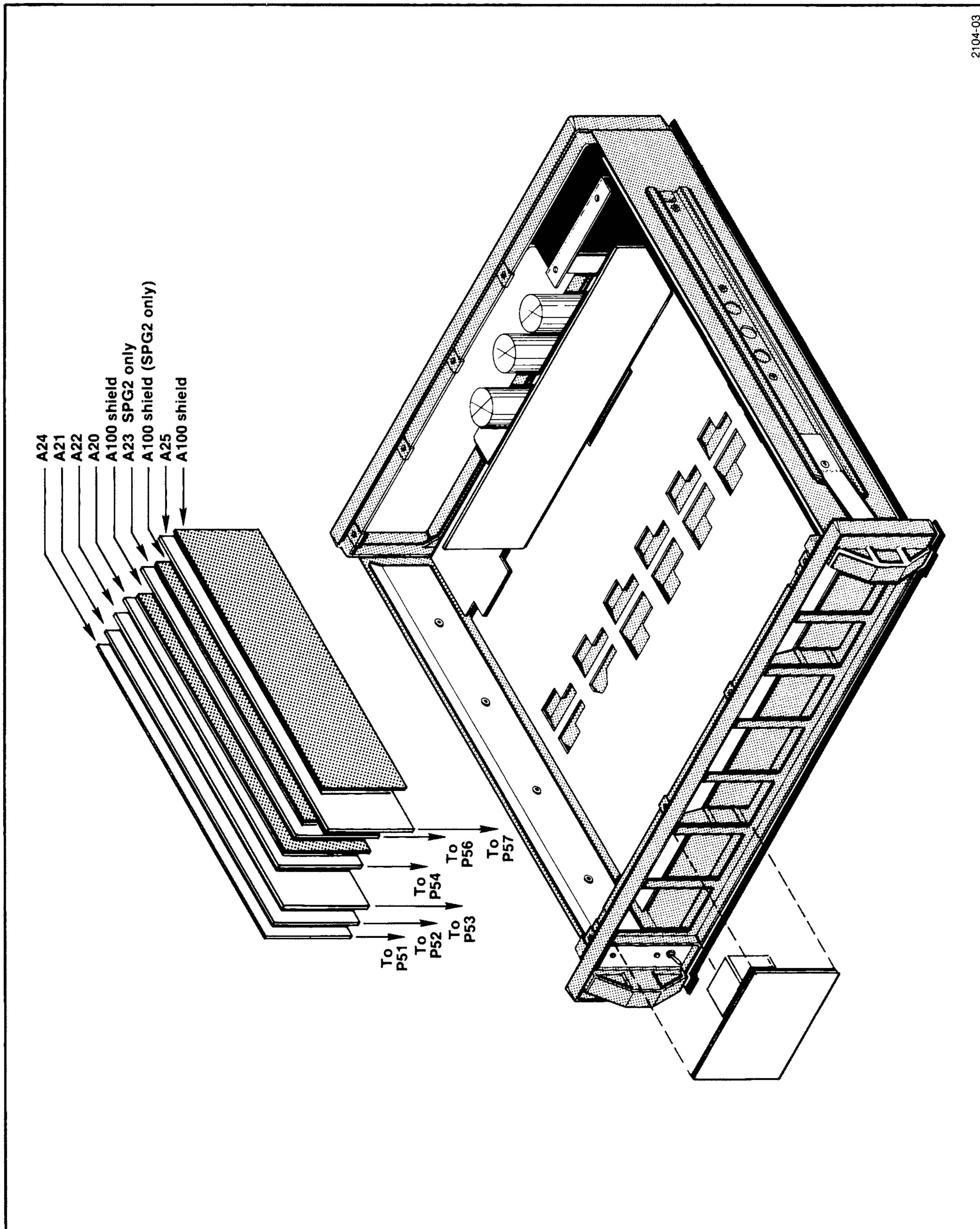


Fig. 3-1. Installation.

P111 Vert Blanking	Selects either fixed or variable Vert Blanking width. Start of Vert Blanking is triggered by command from U129. End of variable Vert Blanking is controlled by R148. P111 is factory-set to pins 2 and 3, variable.
P112 PAL Pulse P113 PAL Pulse Phase	P112 and P113 provide functions not presently used in NTSC systems. P112 selects either a pulse occurring at sync time on alternate lines, or a square-wave that is high for one line, and low for the next. P113 selects either (a) which set of alternate lines the pulse will appear on, or (b) for which set of alternate lines the square-wave is high. P112 is factory-set to pins 1 and 2, square wave; P113 to pins 2 and 3, 90°.
P126 V Blanking Width	Selects either Short V Blanking (20 lines) or Normal blanking width (21 lines). P126 is factory-set to pins 2 and 3, Normal.
P129 Drive Start	Selects either Blanking or Sync as the drive start for the Sync Generator. P129 is factory-set to pins 2 and 3, Blanking.
P169 V Lock	Selects either Fast lock, in which the counter in U129 is immediately reset to incoming vertical sync, or Slow lock, in which the counter is slewed at a rate of one line per field until lock occurs. P169 is factory-set to pins 2 and 3, Fast lock.

A21 Sync Lock

P228 Norm/Slow-Slow	Selects speed of lock between H sync and subcarrier. Normal is a "crash" lock condition, Slow-Slow allows the counter to slew line-by-line to the correct phase. P228 is factory set to pins 2 and 3, Normal.
P224 Sync/Subc Unlock; P324 Timing Jitter	With a jumper installed on P224, incomming signals that do not have sync and subcarrier locked will cause a switch to sync lock. With the jumper installed on P324, switch to internal will occur under conditions of persistent noise on the incoming signal, or sync-subcarrier unlock. The jumper is factory-installed on P324.
P294 Osc Lock	Selects either "crash" lock or slow lock of the horizontal oscillator on the SPG1 or SPG2 Sync Timing board. P294 is factory-set to pins 2 and 3, Fast lock.

A22 Generator Log

P365 Ext Sync	The Needed position requires that external sync be present to operate in the subcarrier lock mode. Not Needed does not require external sync to operate in the subcarrier lock mode. P365 is factory-set to pins 2 and 3, Not Needed.
P366, P374 SPG1/SPG2	P374 enables the Gen Lock mode of operation in SPG2's. If the Subcarrier Lock board is not installed (SPG1), this jumper must be on P366. For SPG2 the jumper must be on P374.
P382 Chrominance Disable	The On position disables subcarrier portions of signals when the SPG1 or SPG2 loses either subcarrier or lock. The Off position causes internal subcarrier to be substituted for external subcarrier on loss of subcarrier or lock. P382 is factory-set to pins 1 and 2, On.
P383 Subcarrier LED Polarity	Selects mode of indication for the front-panel LED. The SUBCARRIER LED can be lit or off when subcarrier is lost. P383 is factory-set to pins 1 and 2, lit when subcarrier is lost.
P386 Video Disable	The On position disables all video outputs upon loss of sync or lock. The Off position substitutes internally-generated sync and subcarrier upon loss of sync or lock. P386 is factory set to pins 2 and 3, Off.
P387 Sync LED Polarity	Selects mode of indication for the front-panel LED. The SYNC LED can be lit or off to indicate the loss of external sync. P387 is factory-set to pins 1 and 2, lit when external sync is lost.
P398 Ext Subcarrier	The Needed position requires that external subcarrier be present to operate in the sync lock mode. Not Needed does not require external subcarrier for sync lock operation. P398 is factory-set to pins 1 and 2, Not Needed.
P399 Gen Lock Subcarrier	The Needed position requires that burst be present to gen lock the SPG2. Not Needed does not require burst on the external videeo signal for gen lock mode. P399 is factory-set to pins 2 and 3, Needed.

A23 Subcarrier Lock

P459 Fast/Slow Lock	Selects speed of subcarrier lock, either "crash" or a slower mode. Controls the subcarrier oscillator on the Subcarrier Input board in the 1410. P459 is factory-set to pins 2 and 3, Fast.
P685 Residual Phase Component	Cancel phase cancels residual subcarrier present on the incoming signal, restoring original burst phase. In the Ignore position, subcarrier phase is the sum of burst phase and residual subcarrier phase on the incoming signal, allowing lock to cw subcarrier. P685 is factory-set to pins 1 and 2, cancel phase.
P690 SIS Delete	On deletes any sound-in-syncs (SIS) from the incoming signal after it passes through the sync stripper. Off does not delete SIS. P690 is factory-set to pins 2 and 3, On.

A24 Pulse Output Amplifier

P836 Field Ref Timing	Selects either field 3 line 10, or field 1 line 11 for generating the Field Reference pulse. P836 is factory-set to pins 2 and 3, field 1 line 11.

A25 VIRS/Black Burst

P855 Sync in Video Disable Mode	If video is disabled under loss of lock conditions by P386 on A22, P855 selects either no output (Off) or sync output (On). P855 is factory-set to pins 2 and 3, Off.
P857 VIRS Line	Selects either line 18 or line 19 for the VIR Signal in Black Burst output mode. P857 is factory-set to pins 2 and 3, line 19.
P858 VIRS Field	Selects either or both fields for the VIR Signal in Black burst output mode. P858 is factory-set to pins 3 and 4, both fields.
P851 VIT Key Source	Selects either internal or external sources for VIT Key. P851 is factory-set to pins 2 and 3 and 5 and 6, internal.
P853 Blanking	Selects either fixed and variable blanking width for the VIRS/Black Burst Signal. P853 is factory-set to pins 2 and 3 and 5 and 6, variable.

RECALIBRATION PROCEDURE

Introduction

This procedure can be used to either verify that the instrument is performing to its rated specifications, or to recalibrate it after repairs or long periods of operation. A short form procedure precedes the Recalibration Procedure and can be used as a calibration record or as an index to the complete procedure.

In the complete procedure, steps or parts of steps that relate to performance check only are identified by the word "Check" in the step heading. Those steps that pertain to both the performance checks and calibration steps are headed "Check/Adjust".

Front-panel control and connector names on the SPG1 or SPG2 are capitalized, for example: SUBCARRIER PHASE. Control and connector names on test equipment or the 1410 mainframe and internal controls in the SPG1 or SPG2 have only the first letter capitalized, for example. Test Oscilloscope Time/Div, 1410 rear-panel Subcarrier input, or SPG1, SPG2 Line Frequency control.

See the circuit board illustrations in Section 8, Servicing Illustrations, of this manual for adjustment locations.

TEST EQUIPMENT

The test equipment listed here was used in preparing this procedure. The measurement capabilities described are the minimum required to recalibrate the instrument. Each piece of test equipment is assumed to be operating within its stated specifications. If alternative equipment is used, it must meet or exceed these requirements.

1. Test Oscilloscope

Dual Time Base. Range from 50 ns/Div to 5 s/Div with provisions for a delaying sweep and television triggering.

Differential Comparator. Bandwidth, dc to 30 MHz; minimum deflection factor, 1 mV/div; two channels capable of differential operation.

Dual Trace Amplifier. Vertical amplier independent of the Differential Comparator. Bandwidth, dc to 30 MHz, minimum deflection factor, 5 mV/Div.

For example, a Tektronix 7603 with 7B53A Option 5 Dual Time Base, 7A13 Differential Comparator, and 7A18 Dual Trace Amplifier.

2. Leveled Sine Wave Generator

Capable of amplitudes from 0.2 volt peak-to-peak, frequency range from 50 kHz to 5 MHz, for example: a Tektronix SG 503 in a TM 500-series Power Unit.

3. Return Loss Bridge

Tektronix Part Number 015-0149-00.

4. 50 Ω to 75 Ω Minimum Loss Attenuator

Tektronix Part Number 011-0057-00.

5. 75 Ω Feed-Through Termination

Two, matched within 0.2% supplied as accessories with the Return Loss Bridge (item 3). Tektronix Part Numbers 011-0103-00 (red), and 011-0103-01 (green).

6. 75 Ω Feed-Through Termination (20)

Tektronix Part Number 011-0103-02.

7. 75 Ω Cable (5)

42 inches long. Tektronix Part Number 012-0074-00.

8. P6053B 10X Probe

Tektronix Part Number 010-6053-11.

9. A test signal generator module (TSG1, TSG2, TSG3, TSG4) mounted in the 1410 along with the SPG1 or SPG2. The test signal generator signal must contain a subcarrier portion at 0 APL with more than 19 cycles of subcarrier.

10. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal, for example: a Tektronix 1410 with SPG1 or SPG2; or a Tektronix 146.

11. Waveform Monitor

Capable of overlaying one portion of a line sweep display on another portion and having sweep magnification to at least .1 μs/Div, for example: a Tektronix 1480-series.

12. Vectorscope

Capable of measuring phase differences between two signals of less than 0.5°, for example: a Tektronix 520A.

13. Spectrum Analyzer

Capable of measuring the third harmonic of the color subcarrier to below −30 dB, for example: a Tektronix 7L12 or 7L5/L2 (7000-Series plug-in units).

14. Frequency Counter

Capable of resolving 0.25 Hz out of 3 MHz, for example: a Hewlett-Packard 5326A Option 011.

15. Calibration Fixture

For use with the Waveform Monitor. See Fig. 4-1.

Calibration Fixture

This fixture and the 1480 Waveform Monitor provide a variable calibration voltage level which can be read directly from a 10-turn dial. The schematic diagram and parts list for the fixture appear in Fig. 4-1. When S1 is in the Fixed position, the 1480 calibrator voltage is determined by the circuit in the fixture.

With P9034 connected to J9034 on the 1480, and S1 in the Fixed position, calibrate the graticule for 140 IRE (1 V). Set the Amplitude dial to 1000 and S1 to Variable. Adjust R3 (CAL), to exactly match the internal 1 V calibrator level. The dial is now calibrated so that each turn of the dial represents 100 mV.

Measurements

The signal to be measured must be fed to the 1480 CH A input, and both the OPER and CAL buttons pushed in. To check amplitude within a given tolerance, adjust the Amplitude dial while watching the waveform monitor display. When the level being measured overlays the blanking level, read the amplitude directly from the dial.

To adjust a signal level, use the Calibration Fixture as a reference. First, set the Amplitude dial to the desired level. Then, adjust the proper control so that the signal level overlays the blanking level. The signal level now matches the Amplitude level.

EQUIPMENT SETUP

1. Test Oscilloscope

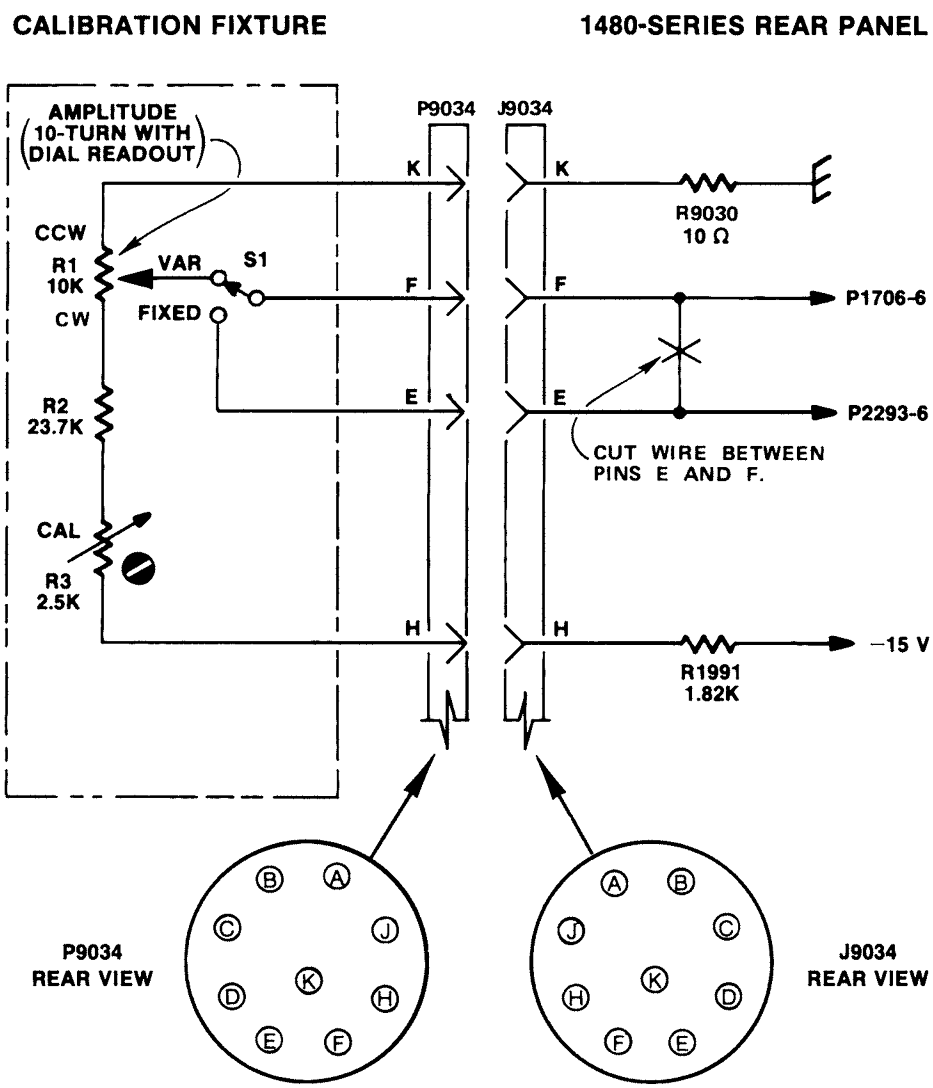
(A 7603 with the 7B53A Option 5 in the right compartment, the 7A18 in the left compartment, and the 7A13 in the center compartment.)

	7603
Power	On
Readout	
Intensity	Best Display
Grat Illum	
Focus	
Vert Mode	Left
Trig Source	Left

	7A13
+Input	DC
−Input	DC
Volts/Div	.1
Variable	Cal
BW	Full

	7A18
Ch 1 and Ch 2	
Volts/Div	1
Variable	Cal
Coupling	DC
Trigger Source	Ch 1
Display Mode	Ch 1
Ch 2 Polarity	+Up

	7B53A
Main Triggering	
Mode	Auto
Coupling	AC
Source	Int
Time/Div	10 μs
Variable	Cal
Mag	X1



Parts List

Ckt No.	Description	Tektronix Part No.
P9034	9-pin Amphenol #165-13	134-0049-00
R1	10 kΩ ±5%, Ind. Lin. ±0.1%, 10-turn, prec. var.	311-1729-00
R2	23.7 kΩ ±1%, 1/8 W, metal film	321-0325-00
R3	2.5 kΩ ±20%, variable	311-0086-00
S1	SPDT toggle switch	260-0613-00
	10-turn dial for R1, Kilo-dial Mod. 461-S-41	331-0139-00
Misc.	Approx. 3 ft. of 4-conductor cable and a small metal or plastic enclosure or case.	

Set R1 fully counterclockwise (ccw) and the dial at 0 when installing the dial.

2329-04

Fig. 4-1. Waveform Monitor Calibration Fixture.

2. 1410 with SPG1 or SPG2 and test signal module

1410	
Power	On
Test Signal Module	Set for signal containing subcarrier at 0 APL

SPG1	
INTERNAL-EXTERNAL	INTERNAL
HORIZONTAL LOCK	SUBCARRIER
BLACK BURST SIG VIRS	ON

SPG2	
INTERNAL-GEN LOCK/EXT	INTERNAL
GEN LOCK-EXTERNAL	GEN LOCK
HORIZONTAL LOCK	SUBCARRIER
BLACK BURST SIG VIRS	ON

When performing the Recalibration Procedure, mount each circuit board in turn on the 1410 Extender board A2. The Extender board allows easy access to the controls on the SPG1 or SPG2 board.

SHORT FORM PROCEDURE

A20 Sync Timing Board

A21 Sync Lock Board

A22 Generator Logic Board

A23 Subcarrier Lock Board (SPG2 Only).

A24 Pulse Output Amplifier Board

A25 VIRS/Black Burst Board

PROCEDURE

A20 Sync Timing Board

1. Check/Adjust Line Frequency (C159)

a. Mount the A20 Sync Timing board on the 1410 Extender board A2. Turn on the 1410 and allow 20 minutes warmup time at +20°C to +30°C.

b. Connect the 10× probe from the Test oscilloscope Dual Trace Amplifier to 1410 Interface line 55.

c. ADJUST—C159 for a dc level of approximately +5 V at Interface line 55.

d. Remove the probe from Interface line 55.

2. Adjust Line Sync Delay Range (S109)

a. SPG1: Apply comp sync and subcarrier signals from the Video Signal Source to the respective Comp Sync and Subcarrier inputs on the rear panel of the 1410/SPG1 under test. Terminate the loop-throughs in 75 ohms.

SPG2: Apply Comp Video or Black Burst from the Video Signal Source to the Gen Lock input on the rear panel of the 1410/SPG2 under test. Terminate the loop-through in 75 ohms.

NOTE

Use a video signal that has proper SCH phasing.

b. Apply comp sync from the Video Signal Source and from the SPG1 or SPG2 front-panel BLACK BURST output through 75 ohm cables and 75 ohm feed-through terminators to the dual-trace amplifier inputs on the test oscilloscope. Externally trigger the test oscilloscope with H Drive from the Video Signal Source.

Set the test oscilloscope controls for dual-trace operation (alternate mode) and ×10 magnification.

c. Set the SPG1 INTERNAL-EXTERNAL push button to EXTERNAL, or the SPG2 INTERNAL-GEN LOCK/EXT push button to GEN LOCK/EXT.

d. CHECK—With all S109 switch sections closed, the 1410 test signal module line sync should lead the Video Signal Source line sync by at least 10 μs.

e. CHECK—With all S109 switch sections open, the 1410 test signal module line sync should lag the Video Signal Source line sync by at least 4 μs.

f. ADJUST—Select combinations of S109 to obtain line sync coincidence of the two displayed line sync pulses.

3. Check/Adjust Vertical Phasing (R169)

a. Use the Video Signal Source V Drive output to externally trigger the test oscilloscope. Return the oscilloscope magnifier control to ×1 and set the sweep rate to 2 ms. Use the delayed sweep function to view the vertical intervals of the two signals.

b. Check—The two displayed signals should coincide.

c. Adjust—R169 (Vertical Phasing) until the two displayed signals coincide. As R169 is adjusted, the display jumps in one-half line increments. The final setting of R169 should be between jumps.

4. Check Field Blanking Duration (Fixed)

a. Place jumper P111 in the Fixed position (pins 1 and 2 connected).

b. Display the SPG1 or SPG2 COMP BLANKING output and composite video from the Video Signal Source simultaneously on the Test Oscilloscope.

c. Set the Test Oscilloscope Time/Div and Delayed Sweep Time/Div to view the vertical interval.

d. Check—The duration of the field blanking pulse should be 20 lines.

5. Check/Adjust Variable V Blanking Stop (R148)

a. Place jumper P111 in the Variable position (pins 2 and 3 connected).

b. Check—The field blanking pulses should end at the beginning of line 21 in field 1, and at the center of line 20 in field 2 (20 lines vertical blanking).

c. Adjust—R148 (Var V Blanking Stop) for the correct position of the end of field blanking. As R148 is adjusted, the display jumps in one-half line increments. The final setting of R148 should be between jumps.

d. Return P111 to the Fixed position.

6. Check Line Blanking Duration (Fixed)

a. Place jumper P103 in the Fixed position (pins 2 and 3 connected); and P110 jumper in the Fixed position (pins 1 and 2 connected).

b. Display signals from the SPG1 or SPG2 front-panel COMP BLANKING connector and the 1410 rear-panel H Drive connector simultaneously on the Test Oscillsocope. Externally trigger the oscilloscope with H Drive from the Video Signal Source.

c. Set the Test Oscilloscope Time/Div to display a horizontal line.

d. Check—Fixed line blanking duration should be 10.7 μs as measured at the 50% amplitude point on the signal.

7. Check/Adjust Variable H Blanking Start (R116) and Variable H Blanking Stop (R115)

a. Place P103 (H Drive) in the Variable position (pins 1 and 2 connected). Place P110 (H Blanking) in the Variable position (pins 2 and 3 connected).

b. CHECK—The leading edges of both COMP BLANKING and H Drive should move simultaneously as R116 is rotated.

c. Remove the H Drive Signal from the Test Oscilloscope and replace it with COMP SYNC from the SPG1 or SPG2.

d. Adjust—R116 so the leading edge of the line blanking starts 1.4 μs before line sync starts.

e. Adjust—R115 for 10.7 μs duration of line blanking.

f. Return P103 to the fixed position (pins 2 and 3 connected). Return P110 to the fixed position (pins 1 and 2 connected).

8. Check/Adjust Color Bars Horizontal Shift (R149).

a. Connect a 10X probe between the Test Oscilloscope and interface line 8 (Color Bars Timing).

b. Set the Test Oscilloscope Time/Div to view the line blanking portion of the waveform (about 2 μs/div).

c. Rotate R149 (Color Bars Horiz Shift) throughout its range. Note that at one end of the range a spike appears just following the falling edge of the waveform, and at the other end of the range the timing pulse jumps.

d. Adjust—R149 (Color Bars Horiz Shift) so that the spike is not present and the timing pulse does not jump.

9. Check/Adjust Burst Delay (R119) and Burst Width (R128).

a. Display the SPG1 or SPG2 BLACK BURST and SUBCARRIER signals simultaneously on the Test Oscilloscope.

b. Using the Test Oscilloscope delayed sweep function, view the line sync area with the main sweep at a field rate and the delayed sweep at about 2 μs.

c. ADJUST—R119 (Burst Delay) for a burst delay time of 5.309 μs ±35 ns, the equivalent of 19 cycles of subcarrier. Burst delay is measured from the start of sync (50% point of leading edge) to the start of burst (the zero crossing preceding the first half cycle of subcarrier that is 50% or greater of the burst amplitude).

d. ADJUST—R128 (Burst Width) for a burst width of 2.51 μs ±70 ns, the equivalent of 9 cycles of subcarrier. Burst width is measured from the start of burst (defined in step 9c) to the end of burst, defined as the zero crossing following the last half cycle of subcarrier that is 50% or greater of the burst amplitude.

e. CHECK—Breezeway, the time from the end of line sync (50% point of trailing edge) to the start of burst, should be approximately 600 ns.

f. Check—The front porch should be 1.49 μs to 1.69 μs in width as measured at the 50% amplitude points on sync and setup with respect to blanking.

10. Check Sync Timing

a. Display the SPG1 or SPG2 COMP SYNC signal on the Test Oscilloscope.

b. Using the Test Oscilloscope delayed sweep function, view the vertical interval area of the signal.

c. Check—Sync timing as follows:

Line sync duration	4.70 μs ±100 ns	measured at 50% points
Equalizing pulse duration	2.3 μs ±100 ns	measured at 50% points
Interval between field sync pulses	4.77 μs ±100 ns	measured at 50% points
Field sync Pulse sequence	6 equalizing pulses— 6 sync pulses— 6 equalizing pulses	

11. Check PAL Pulse

a. Connect a 10X probe between the Test Oscilloscope vertical input and Interface line 20.

b. Place P112 in the Square position (pins 1 and 2 connected).

c. Check—A square-wave should be present on Interface line 20.

d. Move P112 to the Pulse position (pins 2 and 3 connected).

e. Check—A pulse should be present on Interface line 20.

f. Display the SPG1 or SPG2 BLACK BURST signal on the Test Oscilloscope along with the PAL pulse.

g. Check—The PAL pulse should appear on different alternate pairs of video lines as P113 is moved from the 90° position (pins 2 and 3 connected) to the 270° position (pins 1 and 2 connected).

12. Check Split Field Timing

a. Display the SPG1 or SPG2 BLACK BURST signal and the signal on Interface line 27 simultaneously at a fixed rate on the Test Oscilloscope.

b. Place jumper P144 in the 1/2 Field Split position (pins 2 and 3 connected).

c. Check—The signal on Interface line 27 should be low for half the field and high for half the field.

d. Place jumper P144 in the 3/4, 1/4 Field Split position (pins 1 and 2 connected).

e. Check—The signal on Interface line 27 should be low for three-fourths of the field and high for one-fourth of the field.

f. Return jumper P144 to the 1/2 Field Split position.

13. Check V Lock

a. Set the 1410 Power switch Off.

b. Connect comp sync and subcarrier from the Video Signal Source to the proper 1410 rear-panel loop-through inputs.

c. Set the SPG1 or SPG2 INTERNAL/EXTERNAL switch to EXTERNAL.

d. Connect the SPG1 or SPG2 BLACK BURST SIG output and comp video from the Video Signal Source to the Test Oscilloscope.

e. Trigger the Test Oscilloscope externally with comp sync from the Video Signal Source.

f. Place jumper P169 in the Fast position (pins 1 and 2 connected).

g. Set the 1410 Power switch On.

h. Check—The SPG1 or SPG2 should immediately lock to the external signal.

i. Set the 1410 Power switch Off.

j. Move jumper P169 to the Slow position (pins 2 and 3 connected).

k. Set the 1410 Power switch On.

l. Check—The lock to the external signal should be slower than that in part h.

14. Check Timing Outputs

a. Check—Using the 10X probe from the Test Oscilloscope, check for proper outputs at the following Interface lines.

Interface line	Signal	Interface line	Signal
2	PAL Pulse	25	Comp Sync
3	Delayed H	26	Vert Blanking
7	H Drive	27	1/2-3/4 V
8	CB Timing	33	Field Sq. Wave
9	H Blanking	34	H*
10	Comp Blanking	35	H
11	Burst Gate	36	V/2
12	Vert Drive	37	V/4
13	Burst Gate Start	38	16H
		39	Window
		40	5 MHz
21	H/4	41	1 MHz
22	H/2	42	2H
23	H Crosshatch	43	4H
24	V Crosshatch	44	8H

NOTE

If U129 (40-pin MOS/LSI package) is replaced, check for TTL-switching spikes in the timing outputs H, H, 2H, 4H, 8H, and 16H (use Extender board A2). If spikes are present and greater than +0.4 V on any of the outputs, add capacitors or resistors, or both, to the appropriate signal lines, at the locations designated on Diagram 1a, according to the following guidelines:*

Signal	Circuit Numbers	Suggested Values and Ratings
H H* 2H 4H 8H 16H	U128A, C123 U128B, C124 U145A, C142 U145B, C143 U145C, C144 U145D, C145	Use axial lead, tubular ceramic caps of 100 V, 10% ratings. Start with small values. Nominal value should be 47 pF. Maximum value should not exceed 150 pF. Mount caps on backside of board.
4H 8H 16H	U129, R142 U129, R143 U129, R124	Use 5%, 0.25 W rated resistors. Nominal value should be 39 kΩ but can be smaller. Retain some resistance for pull-down on these outputs of the MOS device.

Retain any factory installed parts for the replaced device.

A21 Sync Lock Board

1. Check Sync Lock Loop

a. Connect comp sync and subcarrier from the Video Signal Source to the correct 1410 rear-panel loop-through inputs. If the instrument being calibrated is an SPG2, connect comp video from the Video Signal Source to the correct 1410 rear-panel loop-through input.

b. Set the SPG1 INTERNAL-EXTERNAL switch to EXTERNAL. Set the SPG2 to EXTERNAL/GEN LOCK, and set the EXTERNAL-GEN LOCK switch to GEN LOCK.

c. Set the HORIZONTAL LOCK switch to SUBCARRIER.

d. Connect the 10X probe from the Test Oscilloscope to U284 pin 7.

e. Check—A locked indication is a dc level at U284 pin 7; unlocked is a trapezoidal wave.

2. Check/Adjust HORIZ DELAY (R175)

a. Display the SPG1 or SPG2 BLACK BURST signal and comp video from the Video Signal Source simultaneously on the Test Oscilloscope. Externally trigger the Test Oscilloscope from the Video Signal Source.

b. Check—The leading edges of the two displayed line sync pulses should coincide.

c. Adjust—HORIZ DELAY (R175) until the sync pulses leading edges coincide.

NOTE

If the HORIZ DELAY control does not match the leading edges of the two line sync pulses, set S109 on the Sync Timing board A20 to bring the SPG1, SPG2 sync pulse within the range of the HORIZ DELAY control.

d. Check—The total range of the HORIZ DELAY control should be at least 1 μs.

3. Check Slow-Fast Lock

a. Connect a 10X probe from the Test Oscilloscope to U284 pin 1.

b. Place jumper P294 in the Fast position (pins 2 and 3 connected).

c. Press the front-panel HORIZ UNLOCK button.

d. Check—The signal at U284 pin 1 should be approximately 3 volts in amplitude.

e. Move jumper P294 to the Slow position (pins 1 and 2 connected).

f. Press the front-panel HORIZ UNLOCK button.

g. Check—The signal of U284 pin 1 should be much larger than 3 volts in amplitude.

h. Release the HORIZ UNLOCK button.

4. Check ÷455 Counter Operation

a. Connect a 10X probe from the Test Oscilloscope to TP239.

b. Check—The signal at TP239 should be a square-wave with a period equal to one horizontal line.

5. Check/Adjust Lower Phase Reset (R209), Lower Phase Advance (R198), Upper Phase Retard (R199), Upper Phase Reset (R189), and Preset Center (R276)

a. Display composite video from the Video Signal Source on the Waveform Monitor and the Test Oscilloscope. (The composite video signal must contain at least 19 cycles of subcarrier at 0 APL, and must be displayed on VITS line 18. For example: a linearity test signal with steps removed).

b. Display the Field Reference pulse from the 1410 rear panel on the Test Oscilloscope simultaneously with the composite video from the Video Signal Source.

c. Display VIRS from the SPG1 or SPG2 on the Vectorscope.

d. Externally trigger the Test Oscilloscope and externally sync the Waveform Monitor with composite sync from the Video Signal Source.

e. Externally reference the Vectorscope to the Video Signal Source subcarrier.

f. Set the Test Oscilloscope Time/Div to view four fields of composite video.

g. Set the Waveform Monitor Field switch to 1, Line Selector to Digital and line 17, and Time/Div to 10 μs/Div.

h. Using the Waveform Monitor Waveform Comparison controls, overlay the 0 APL subcarrier on line 18 over line 18 sync and burst.

i. Set the Waveform Monitor Magnifier to .2 μs/Div and view the sync and burst area of line 18.

j. Adjust the Waveform Monitor Waveform Comparison Overlay control until subcarrier and burst are exactly in phase.

k. Using the Waveform Monitor Position controls, set the 50% amplitude point of the leading edge of sync on a reference point somewhere along the graticule 0 IRE line.

l. Using the Waveform Monitor Vertical Position control only, set the zero crossing of the overlaid subcarrier on the graticule 0 IRE line.

m. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control so that the zero crossing of a positive slope of one cycle of subcarrier falls on the same reference point used in part k of this step.

n. Set SPG1 for External mode, SPG2 for Gen Lock mode.

o. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to 0 on the dial and rotate the Vectorscope Phase control to set the VIRS vector to 180° on the Vectorscope.

p. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control in the direction that causes the Vectorscope display to move clockwise until the Field Reference pulse displayed on the Test Oscilloscope shifts one television frame in time.

q. Check—The VIRS vector displayed on the Vectorscope should fall at approximately 45°.

r. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control in the direction that moves the Vectorscope display counter-clockwise until the Field Reference pulse displayed on the Test Oscilloscope shifts back to the original television frame.

s. Check—The VIRS vector displayed on the Vectorscope should fall at approximately 135°.

t. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to move the VIRS vector in a counter-clockwise direction until the Field Reference pulse again shifts one television frame.

u. Check—The VIRS vector should fall at approximately 315°.

v. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to move the VIRS vector in the clockwise direction until the Field Reference pulse shifts back to its original television frame.

w. Check—The VIRS vector should fall at approximately 225°.

NOTE

If the limits above have not been met, continue through the remaining portion of Step 5.

aa. Set R198 (Lower Phase Advance) and R199 (Upper Phase Retard) so that U205 pins 7 and 4 are at the maximum voltage apart (at the stops of the controls).

ab. Center R209 (Lower Phase Reset) and R189 (Upper Phase Reset).

ac. Ground TP229 and place jumper P228 in the Normal position (pins 1 and 2 connected).

ad. Connect the 10X probe from the Test Oscilloscope to the junction of R198 and R199. Note the voltage level.

ae. Move the 10X probe to TP244.

af. Check—The voltage level at TP244 should be the same as that noted in part ad.

ag. Adjust—R276 (Preset Center) for the same voltage level as that noted in part ad.

ah. Remove the ground from TP229.

ai. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to place the VIRS vector at 45° on the Vectorscope.

aj. Adjust—R199 (Upper Phase Retard) until the Field Reference pulse displayed on the Test Oscilloscope shifts one television frame in time.

ak. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to move the VIRS vector counter-clockwise to 315°.

al. Adjust—R198 (Lower Phase Advance) until the Field Reference pulse shifts one frame.

am. Rotate the SPG1 or SPG2 SUBCARRIER PHASE control to move the VIRS vector clockwise to 225°.

an. Check—The Field Reference pulse should shift back to its original position.

6. Check/Adjust SCH ϕ Center (R219)

a. Without disturbing the equipment setup of Step 5, connect the Waveform Monitor Line Strobe Out to the Test Oscilloscope. (Use the + Input of the Differential Comparator, set the 7603 Vert Mode to Chop.)

b. Check—The Line Strobe from the Waveform Monitor and the Field Reference pulse from the 1410 should fall in the same television frame.

c. Adjust—R219 (SCH ϕ Center) until the Line Strobe from the Waveform Monitor and the Field Reference pulse from the 1410 fall in the same frame.

7. Check SCH Phasing

a. Check—The Field Ref signal from the 1410 rear panel should shift one frame in time with each 180° of rotation of the Video Signal Source Subcarrier Phase control.

8. Check/Adjust Subcarrier to Sync Lock Timing (R208)

NOTE

Make certain that the SPG1 or SPG2 SUBCARRIER PHASE control is still set to 0 on the dial, and that the equipment setup done in Step 5 is not disturbed.

a. Display the SPG1 or SPG2 BLACK BURST signal on the Test Oscilloscope. The SPG1 or SPG2 should still be in an external lock mode.

b. Externally trigger the Test Oscilloscope from the Video Signal Source.

c. Check—The display should not shift as the HORIZONTAL LOCK is switched between SUBCARRIER and SYNC.

d. Adjust—R208 (Subcarrier to Sync Lock Timing) for no display shift as HORIZONTAL LOCK is switched between SUBCARRIER and SYNC.

e. Set the SPG1 or SPG2 to INTERNAL.

f. Trigger the Test Oscilloscope internally.

g. Press the SPG1 or SPG2 front-panel HORIZ UNLOCK button.

h. Check—The subcarrier portion of the displayed signal should free run.

9. Check Normal/Slow-Slow Lock

a. Display signals from the Video Signal Source and the SPG1 or SPG2 simultaneously on the Test Oscilloscope.

b. Trigger the Test Oscilloscope externally from the Video Signal Source.

c. Set the SPG1 or SPG2 to INTERNAL.

d. Place P228 in the Normal position (pins 1 and 2 connected).

e. When the two displayed signals are one-half line apart, set the SPG1 or SPG2 to EXTERNAL.

f. Check—The SPG1 or SPG2 should immediately lock to the external source.

g. Move P228 to the Slow-Slow position (pins 2 and 3 connected).

h. Set the SPG1 or SPG2 to INTERNAL, press the HORIZ UNLOCK button wait until the two displayed signals are one-half line apart, then release the HORIZ UNLOCK button and set the SPG1 or SPG2 to EXTERNAL.

i. Check—The SPG1 or SPG2 should slowly lock to the external source.

j. Monitor the level at the emitter of Q217 (at TP217) with the 10X probe from the Test Oscilloscope.

k. Check—The level at the emitter of Q217 should go high when the displayed signal is moving to the right during Slow-Slow lock.

l. Move P228 to the Normal position.

m. Check—The level at the emitter of Q217 should be 0 volt at all times in Normal lock.

10. Check Sync/Subcarrier Unlock Switch to Sync Lock and Timing Jitter Switch to Internal

Note

P224 and P324 route different commands to the Generator Logic board A22 depending on which pair of the two pairs of pins are connected together. A jumper is installed on P324 at the factory, leaving P224 open. When P224 is to be used, remove the jumper from P324 and place it on P224.

a. Place the jumper on P324.

b. Press the Video Signal Source SPG1 or SPG2 front-panel Horizontal Unlock button.

c. CHECK—the SPG1 or SPG2 HORIZONTAL LOCK LED should flash on and off.

d. Move the jumper to P224.

e. Press the Video Signal Source SPG1 or SPG2 front-panel Horizontal Unlock button.

f. CHECK—the SPG1 or SPG2 SUBCARRIER LED should flash on and off.

g. Return the jumper to P324.

A22 Generator Logic Board

1. Check INTERNAL Mode Operation

a. Connect composite sync, subcarrier, and composite video from the Video Signal Source to the appropriate 1410 rear-panel loop-through connectors.

b. Set the SPG1 or SPG2 for INTERNAL operation.

c. Display the SPG1 or SPG2 BLACK BURST signal and a signal from the Video Signal Source simultaneously on the Test Oscilloscope. Trigger the Test Oscilloscope externally from the Video Signal Source.

d. Place P383 and P387 jumpers for the desired SYNC and SUBCARRIER LED indication. (P387 SYNC, pins 1 and 2 connected, lit when external sync is absent; pins 2 and 3 connected, lit when external sync is present. P383 SUBCARRIER, pins 1 and 2 connected, lit when external subcarrier is absent, pins 2 and 3 connected, lit when external subcarrier is present.)

e. Check—The front-panel INTERNAL LED should be lit and the two signals displayed on the Test Oscilloscope should not be locked.

2. Check SYNC Lock EXTERNAL Mode Operation

a. Set the SPG1 or SPG2 for EXTERNAL operation. Set HORIZONTAL LOCK to SYNC.

b. Place P386 jumper in the "Can" position (pins 2 and 1 connected). Place P855 in "on" position (pins 1 and 2).

c. Check—The SYNC and SUBCARRIER LED's indicate the presence of external sync and subcarrier.

d. Check—The two signals displayed on the Test Oscilloscope should be locked.

e. Remove composite sync from the 1410 rear-panel loop-through connector.

f. Check—The SYNC LED should change states, the INTERNAL LED should be lit, and BLACK BURST displayed on the Test Oscilloscope will go to zero.

g. Connect composite sync to the appropriate 1410 rear-panel loop-through connector.

h. Re-position all jumpers.

i. Remove subcarrier from the 1410 rear-panel loop-through connector.

j. Check—The SUBCARRIER LED should change states, and the two signals displayed on the Test Oscilloscope should remain sync-locked, but subcarrier will go to zero.

k. Move P398 jumper to the Ext Subc Needed position (pins 2 and 3 connected).

l. Check—The SUBCARRIER LED should continue to indicate absence of external subcarrier, the INTERNAL LED should be lit, and the two signals displayed on the Test Oscilloscope should not be locked.

m. Re-position P398.

3. Check SUBCARRIER Lock EXTERNAL Mode Operation

a. Set the SPG1 or SPG2 HORIZONTAL LOCK to SUBCARRIER.

b. Check—The SUBCARRIER LED should indicate the absence of external subcarrier, the INTERNAL LED should be lit, and the two signals displayed on the Test Oscilloscope should not be locked.

c. Move P398 jumper to the Ext Subc Not Needed position (pins 1 and 2 connected).

d. Check—The SYNC and SUBCARRIER LED's should not change, the SYNC LOCK LED should be on, and the two signals displayed on the Test Oscilloscope should be sync-locked.

e. Remove composite sync from the 1410 rear-panel loop-through connector. Connect subcarrier to the 1410 rear-panel Subcarrier loop-through connector.

f. Check—The SYNC and SUBCARRIER LED's should change states, the SYNC LOCK LED should be off, and the two signals displayed on the Test Oscilloscope should be locked.

g. Move P365 to the Ext Sync Needed position (pins 1 and 2 connected).

h. Check—The SYNC and SUBCARRIER LED's should not change, the INTERNAL LED should be on, and the two signals displayed on the Test Oscilloscope should not be locked.

i. Re-position P365 to pins 2 and 3.

4. Check LED Polarity and Chroma and Video Disable

a. Connect composite sync to the 1410 rear-panel Sync loop-through connector.

b. Check—The SYNC and SUBCARRIER LED's should not be lit.

c. Remove external sync and subcarrier from the 1410 rear-panel loop-through connectors.

d. Check—The SYNC and SUBCARRIER LED's should be lit.

e. Move P383 and P387 jumpers to the Sync Present and Subc Present positions (pins 2 and 3 connected).

f. Check—The SYNC and SUBCARRIER LED's should not be lit.

g. Connect external sync and subcarrier to the appropriate 1410 rear-panel loop-through connectors.

h. Check—The SYNC and SUBCARRIER LED's should be lit.

i. Re-position P383 and P387 to pins 1 and 2.

j. Connect the 10X probe from the Test Oscilloscope to Interface line 31.

k. Check—Interface line 31 should be low under all conditions.

l. Move P382 to the Can position (pins 1 and 2 connected).

m. Remove external sync and subcarrier from the 1410 rear-panel loop-through connectors.

n. Check—Interface line 31 should be high.

o. Place P386 in the Can position (pins 1 and 2 connected).

p. Move the 10X probe to Interface line 32.

q. Check—Interface line 32 should be high.

r. Connect external sync and subcarrier to the appropriate 1410 rear-panel loop-through connectors.

s. Move P386 to the Can't position (pins 2 and 3 connected).

t. Check—Interface line 32 should be low under all conditions.

5. Check GEN LOCK Mode (SPG2 Only)

a. Set the SPG2 for GEN LOCK operation.

b. Remove composite sync from the Video Signal Source composite video signal.

c. Check—The SYNC and SUBCARRIER LED's should change states and the INTERNAL LED should be lit.

d. Restore composite sync to the Video Signal Source composite video signal. Move P399 to "Needed" position (pins 2 and 3).

e. Remove burst from the Video Signal Source composite video signal.

f. Check—The SUBCARRIER LED should change states and the INTERNAL LED should be lit.

g. Move P399 to the Not Needed position (pins 1 and 2 connected).

h. Check—The INTERNAL LED is not lit.

i. Restore burst to the Video Signal Source composite video signal.

A23 Subcarrier Lock Board (SPG2 Only)

1. Check/Adjust Sync Stripper (R707, R749)

a. Connect composite video from the Video Signal Source to the 1410 rear-panel Gen Lock loop-through input connector.

b. Terminate the loop-through connector into 75 ohms.

c. Set the SPG2 for GEN LOCK mode of operation.

d. Connect the 10X probe from the Test Oscilloscope to Interface line 53.

e. Check—The sync pulse present on Interface line 53 should have no step at the trailing edge.

f. Set R707 (SIS Lockout) so that the voltage at R707 wiper arm is maximum positive (+14.6 V to +15 V).

g. Adjust—Preset R749 (noise Lockout) to maximum positive voltage (+7 V or higher) at R749 wiper arm. Then, readjust R749 to just eliminate the step at the sync pulse trailing edge.

2. Check AGC

a. Connect the 10X probe from the Test Oscilloscope to TP714.

b. Check—The signal amplitude at TP714 should remain constant as the input signal amplitude is varied from one-half to two times nominal (1 volt).

NOTE

Three 75 Ω terminations in series with the input signal reduces the amplitude to one-half. An unterminated input signal is two times nominal (1 volt).

c. Check—The SUBCARRIER LED should not be lit within the AGC range.

3. Check/Adjust Subcarrier Phase (L679)

a. Connect the 10X probe from the Test Oscilloscope to TP668.

b. Adjust—L679 (Subcarrier Phase) for maximum dc level at TP668.

c. Connect the SPG2 BLACK BURST signal on the Vectorscope.

d. Lock the Vectorsope to the Video Signal Source subcarrier.

e. Check—The burst phase displayed on the Vectorscope should not vary more than ±3° as the input signal amplitude is varied from one-half to two times nominal.

4. Check Phase Stability with Dynamic APL

a. Apply a composite video signal that is variable in Average Picture Level from the Video Signal Source to the 1410 rear-panel Gen Lock loop-through input.

b. Check—The phase of the signal displayed on the Vectorscope should change by 0.1° or less as the input APL is varied from 10% to 90%.

5. Check Phase Response to Residual Subcarrier

a. Display the Video Signal Source subcarrier and composite video signal simultaneously on the Vectorscope.

b. Lock the Vectorscope to the Video Signal Source subcarrier.

c. Rotate the Video Signal Source Subcarrier Phase control to set the burst phase 90° from the subcarrier phase. Do not move the Video Signal Source subcarrier Phase control for the remainder of this step.

d. Remove the Video Signal Source composite video and subcarrier from the Vectorscope signal inputs. Leave the Vectorscope locked to the Video Signal Source subcarrier.

e. Display the SPG2 SUBCARRIER and BLACK BURST signals simultaneously on the Vectorscope.

f. Rotate the SPG2 SUBCARRIER PHASE control to set the BLACK BURST phase 90° from the SUBCARRIER phase.

g. Remove the 75 Ω termination from the 1410 rear-panel Gen Lock loop-through connector.

h. Connect subcarrier from the Video Signal Source through the 10X 75 Ω attenuator to the 1410 rear-panel Gen Lock loop-through connector. Composite video Signal Source should still be connected to the other side of the Gen Lock connector.

i. Set P685 to the Ignore position (pins 2 and 3 connected).

j. Check—The phase of the BLACK BURST signal displayed on the Vectorscope should change 15° or more when the subcarrier signal is removed from the 1410 rear-panel Gen Lock loop-through connector.

k. Reconnect Video Signal Source subcarrier through the 10X 75 Ω attenuator to the 1410 rear-panel Gen Lock loop-through connector.

l. Move P685 jumper to the Cancel position (pins 1 and 2 connected).

m. Check—The phase of the BLACK BURST signal displayed on the Vectorscope should change 10° or less when the subcarrier signal is removed from the 1410 rear-panel Gen Lock loop-through connector.

n. Terminate the 1410 rear-panel Gen Lock loop-through connector in 75 Ω.

6. Check SUBCARRIER PHASE Range

a. Rotate the SPG2 SUBCARRIER PHASE control.

b. Check—The phase of the signal displayed on the Vectorscope should change 360° for each 360° rotation of the SUBCARRIER PHASE control.

7. Check Fast/Slow Lock

a. Connect the 10X probe from the Test Oscilloscope to TP456.

b. Move P459 jumper to the Slow position (pins 2 and 3 connected).

c. Check—The dc voltage at TP456 should move only slightly as the Video Signal Source burst is turned off and then restored.

d. Place P459 jumper in the Fast position (pins 1 and 2 connected).

e. Check—The dc voltage at TP456 should near 0 volt briefly as the Video Signal Source burst is turned off and then restored.

8. Check Horizontal Jitter

a. Display the SPG2 BLACK BURST signal on the Test Oscilloscope.

b. Externally trigger the Test Oscilloscope with composite sync from the Video Signal Source.

c. Using the Test Oscilloscope delayed sweep function and magnifier, view the leading edge of a line sync pulse at 20 ns/div (.2 μs/div X10 mag).

d. Check—With the SPG2 HORIZONTAL LOCK in SYNC, jitter on the sync pulse leading edge should be 10 ns or less. With HORIZONTAL LOCK in SUBCARRIER, jitter should not exceed 4 ns.

9. Check/Adjust Oscillator Frequency (R456)

a. Remove the composite video signal from the 1410 rear-panel Gen Lock loop-through connector.

b. Connect the SPG2 SUBCARRIER output to the Frequency Counter.

c. Check—Subcarrier frequency should be within 10 Hz of 3.579545 MHz if the SPG2 is installed in a 1410, or within 1 Hz of 3.579545 MHz if the SPG2 is installed in a 1410 Option 1.

d. Adjust—R456 (Oscillator Frequency) for 3.579545 MHz.

A24 Pulse Output Amplifer Board

1. Check/Adjust Subcarrier Amplitude (C779, 1410 C496)

a. Connect one of the 1410 rear-panel Subcarrier outputs through 75 Ω termination to the Test Oscilloscope.

b. Check—The Subcarrier signal should be 1.8 volts peak-to-peak to 2.2 volts peak-to-peak in amplitude.

c. Adjust—C779 (Subcarrier Amplitude) for 2.0 volts peak-to-peak Subcarrier signal amplitude.

d. Check—The other 1410 rear-panel Subcarrier output should be identical to the first.

e. Connect the SPG1 or SPG2 SUBCARRIER output through 75 Ω termination to the Test Oscilloscope input.

NOTE

The SPG1 or SPG2 SUBCARRIER output is driven directly from the Subcarrier Output Amplifier on the 1410 Subcarrier Input board, A13. This output is provided as a subcarrier phase reference. The subcarrier signal phase at the SPG1 or SPG2 front panel cannot be varied with the SUBCARRIER PHASE control, but is always the same as the reference subcarrier (either from the 1410 Subcarrier Oscillator or from an external source). The Subcarrier Amplitude control on the 1410 Subcarrier Input board, A13 (C496), must be adjusted to set the amplitude of the SUBCARRIER output signal. See the 1410 manual for adjustment location.

f. Check—The SUBCARRIER signal should be 1.8 volts peak-to-peak to 2.2 volts peak-to-peak.

g. Adjust—C496 (Subcarrier Amplitude) on the 1410 Subcarrier Input board, A13, for 2.0 volts peak-to-peak SUBCARRIER signal amplitude.

2. Check/Adjust Comp Blanking Compensation (C798, C808, C809)

a. Connect the SPG1 or SPG2 COMP BLANKING output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Rise and fall time should be 120 ns to 160 ns.

d. Adjust—C798 (Rate) for 120 ns to 160 ns rise and fall times.

e. Repeat this step for each of the two 1410 rear-panel Comp Blanking outputs. Adjust C808 for the signal at J12 and C809 for the signal at J13.

3. Check/Adjust Comp Sync Compensation (C799, C838, C839)

a. Connect the SPG1 or SPG2 COMP SYNC output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Rise and fall times should be 120 ns to 160 ns.

d. Adjust—C799 (Rate) for 120 ns to 160 ns rise and fall times.

e. Repeat this step for each of the two 1410 rear-panel Comp Sync outputs. Adjust C838 for the signal at J10 and C839 for the signal at J11.

4. Check/Adjust Burst Flag Compensation (C818), Burst Flag Delay (R800), and Burst Flag Width (R820)

a. Connect the 1410 rear-panel Burst Flag output through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Rise and fall times should be 120 ns to 160 ns.

d. Adjust—C818 (Rate) for 120 ns to 160 ns rise and fall times.

e. Externally trigger the Test Oscilloscope with the SPG1 or SPG2 COMP SYNC signal.

f. Connect one of the 1410 rear-panel Comp Sync outputs through 75 Ω termination to the Test Oscilloscope so that comp sync and burst flag are displayed simultaneously.

g. Note the position of the leading edge of line sync.

h. Check—The leading edge of the Burst Flag pulse should be 5.3 μs ±35 ns from the leading edge of line sync.

i. Adjust—R800 (Burst Flag Delay) so that the leading edge of the Burst Flag pulse is 5.265 μs to 5.335 ns from the leading edge of line sync.

j. Check—The half-amplitude width of the Burst Flag pulse should be 2.5 μs ±70 ns.

k. Adjust—R820 (Burst Flag Width) for 2.43 μs to 2.57 μs half-amplitude width of the Burst Flag pulse.

5. Check/Adjust H Drive Compensation (C819, C848)

a. Connect 1410 rear-panel H Drive output J16 through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Rise and fall times should be 120 ns to 160 ns.

d. Adjust—C819 (Rate) for 120 ns to 160 ns rise and fall times.

e. Repeat this step for H Drive output J15 on the 1410 rear panel. (Adjust C848 for correct 120 ns to 160 ns rise and fall times.)

6. Check/Adjust V Drive Compensation (C828, C849)

a. Connect 1410 rear-panel V Drive output J18 through 75 Ω termination to the Test Oscilloscope input.

b. Check—The signal amplitude should be 3.8 volts to 4.2 volts.

c. Check—Rise and fall times should be 120 ns to 160 ns.

d. Adjust—C849 (Rate) for 120 ns to 160 ns rise and fall times.

e. Repeat this step for V Drive output J19 on the 1410 rear panel. (Adjust C828 for 120 ns to 160 ns rise and fall times.)

7. Check/Adjust Field Reference Compensation (C829)

a. Connect the 1410 rear-panel Field Ref output J14 through 75 Ω termination to the Test Oscilloscope input.

b. Connect the SPG1 or SPG2 BLACK BURST signal through 75 Ω termination to the other Test Oscilloscope input.

c. Externally trigger the Test Oscilloscope with V Drive from the 1410 rear panel.

d. Check—The Field Ref signal amplitude should be 3.8 volts to 4.2 volts.

e. Check—Rise and fall times should be 120 ns to 160 ns.

f. Adjust—C829 (Rate) for 120 ns to 160 ns rise and fall times.

g. Place P836 in the Field 1, line 11 position.

h. Check—The Field Ref pulse should be at line 11 of Field 1.

i. Move P836 to the Field 3, line 10 position.

j. Check—The Field Ref pulse should be at line 10 of Field 3.

8. Check Return Loss

a. Remove all connections from the SPG1 or SPG2, the 1410, and the Test Oscilloscope.

b. Set the SPG1 or SPG2 for INTERNAL operation.

c. Trigger the Test Oscilloscope internally.

d. Connect the Return Loss Bride to the Test Oscilloscope Differential Comparator.

e. Connect the Leveled Sine Wave Generator through 50 Ω cable and the 50 Ω to 75 Ω Minimum Loss Attenuator to the Return Loss Bridge input.

f. Set the Leveled Sine Wave Generator Frequency Range to Ref ≈ .05 (50 kHz), and the Test Oscilloscope Volts/Div to .1 V. Set the Differential Comparator for differential operation.

g. Remove the 75 Ω termination from the Return Loss Bridge Unkown arm and adjust the Leveled Sine Wave Generator Output Amplitude control for 500 mV display amplitude.

h. Replace the 75 Ω termination on the Return Loss Bridge Unknown arm.

i. Set the Test Oscilloscope Volts/Div to 10 mV.

j. Adjust the Return Loss Bridge Balance control for minimum display amplitude.

k. Remove the 75 Ω termination from the Return Loss Bridge unknown arm.

l. Check return loss of all outputs on the SPG1 or SPG2 front panel and the 1410 rear panel by connecting the unterminated Unknown arm to each connector and checking the Test Oscilloscope display amplitude for 16 mV or less.

NOTE

When checking SPG1 or SPG2 SUBCARRIER return loss, remove Q464 on the 1410 Subcarrier Input board, A13. When checking the return loss of the Subcarrier outputs on the 1410 rear panel, remove Q767 on the SPG1 or SPG2 Pulse Output Amplifier board, A24.

m. Check return loss of the loop-through inputs on the 1410 rear panel by connecting the Unknown arm to one side of the of the loop-through connector and the 75 Ω termination to the other side. Check for 3 mV display amplitude.

n. Remove the Return Loss Bridge.

9. Check Isolation

a. Check all double and triple outputs for active and passive isolation in the following manner:

Passive Isolation. Connect the output of interest through 75 Ω termination to the Test Oscilloscope input. Observe the signal amplitude at that output while shorting another output of the same signal to ground. The observed signal amplitude should change by no more than 1%.

Active Isolation. Observe the output of interest on the Test Oscilloscope while introducing a subcarrier signal into another output of the same signal. The subcarrier signal should be attenuated at the observed output by at least 30 dB. The introduced subcarrier signal amplitude should be varied from 0.5 volt to 4.0 volts.

A25 VIRS/Black Burst Board

NOTE

The adjustments in this step affect the harmonic content of the output signal. Only slight adjustment from the original calibration should be attempted without using a spectrum analyzer.

1. Check/Adjust Full Field Reference Signal Amplitude (R978)

a. Connect the SPG1 or SPG2 BLACK BURST signal output to the 1480 CH A input and terminate in 75 Ω. Set the Full Field Reference switch S838 to the on position.

b. Set the 1480 Display to 10 μs/div, Volts Full Scale to 0.5, and push in the Cal and Oper switches.

c. Check—Using the Amplitude dial for the Calibration Fixture to match the sync with blanking, read 286 mV ±3.6 mV.

d. Adjust—R978 (Gain) for 286 mV of sync amplitude.

2. Check/Adjust DC Level (R969)

a. Set the 1480 Volts Full Scale to 1.0, Display to 10 μs/div, push in the Oper switch, and set the DC Restorer Off and the Response switch to Aux Video In. Position the trace to the 0 IRE graticule line and move the BLACK BURST signal output cable to the 1480 Aux Video In connector.

b. Check—The waveform blanking level should be 0 V ±50 mV (±7 IRE).

c. Adjust—R969 (DC Level) for a 0 volt blanking level. Recheck Step 1 signal amplitude after making this adjustment. Return the BLACK BURST signal output cable to the 1480 CH A input connector.

3. Check VIRS Luminance Levels

a. Remove Q944 to disable VIRS chrominance.

b. Check—Use the Calibration Fixture to read the following:

Setup Level—53.57 mV ±3.57 mV
Gray Level—357 mV ±3.57 mV
Chrominance Pedestal—500 mV ±5 mV

4. Check/Adjust VIRS Luminance Risetime (L981, L984)

a. Set the 1480 to measure risetime—Mag at .1 μs/div.

b. Check—Luminance risetime should be 260 ns ±37.5 ns.

c. Adjust—L981 and L984 (Virs Lum Shape) for correct risetime and minimum aberrations. Graticule A of the 1480 Waveform Monitor has built-in rise and fall time measurement capability. Point R at 80 IRE Units aligns with T on the 0 IRE Unit reference line.

To measure rise or fall time, set the transition amplitude to 100 IRE Units (use the VARiable Volts Full Scale). Vertically position the display so that the transition is from the −10 IRE Unit line to the +90 IRE Unit line. Use the 100 ns/div time base and horizontally position the rise (or fall) of the transition through point R on the short 2 IRE Unit/div scale. Measure the distance from point T on the 0 IRE Unit reference line to where the transition crosses the reference line.

5. Check/Adjust Sync Risetime (L971, L974)

a. Check—Sync risetime should be 130 ns ±20 ns −10 ns.

b. Adjust—L971 and L974 (Sync Shape) for correct risetime and minimum aberrations.

c. Replace Q944.

6. Check/Adjust Burst Risetime (L911)

NOTE

Adjustments in Steps 6, 7, and 8 should not be performed unless absolutely necessary.

a. Push in the HORIZ UNLOCK pushbutton on the SPG front panel.

b. Check—Burst risetime should be 400 ns ±60 ns.

c. Place the Test Oscilloscope 10X probe on TP911.

d. Check—For square burst gate corners and minimum aberrations.

e. Adjust—L911 (Burst Gate Shape) for square burst gate corners and minimum aberrations.

7. Check/Adjust VIRS Chrominance Risetime (L923, L933)

a. Push in the HORIZ UNLOCK pushbutton on the SPG front panel.

b. Check—Chrominance risetime should be 1 μs ±150 ns.

c. Place the Test Oscilloscope 10X probe on TP924.

d. Check—For best shape and minimum aberrations.

e. Adjust—L923 and L933 (Chrom. Timing Shape) for best shape and minimum aberrations.

8. Adjust Chrominance Bandpass Filter (L938, L948)

NOTE

The adjustments in this step affect the harmonic content of the output signal. Only slight adjustment from the original calibration should be attempted without using a spectrum analyzer.

a. Connect the BLACK BURST signal output to the Spectrum Analyzer and display the chrominance signal.

b. Adjust—L938 and L948 (Chrominance Bandpass Filter) for best compromise between Fig. 4-2 and third order harmonics of −30 db or more.

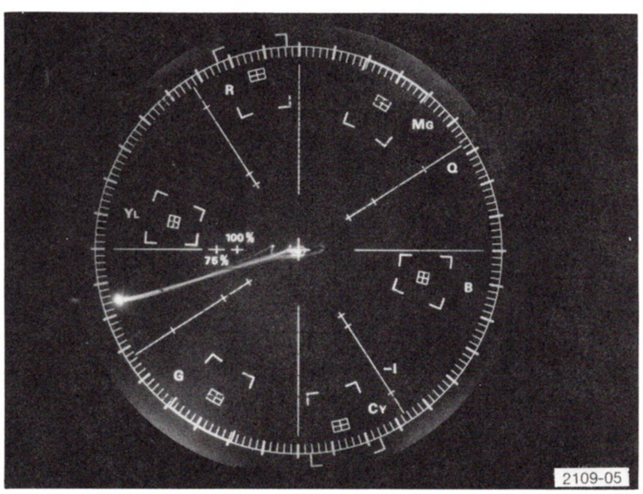


Fig. 4-2. Chrominance Bandpass Filter adjusted for best vector overlay.

9. Check/Adjust Residual Subcarrier (C928, R904)

a. Set the 1480 VFS to 0.2 and position the blanking level at the 0 IRE graticule line.

b. Check—Residual subcarrier should be 2.5 mV or less.

c. Adjust—C928 and R904 (Residual Subcarrier) for 2.5 mV or less residual subcarrier.

10. Check/Adjust Chrominance Amplitude (R958)

a. Set the 1480 to Cal mode. Use the Calibration Fixture Amplitude control to position the top and bottom of chrominance packet to the blanking level. Subtract the two readings to obtain the actual amplitude.

b. Check—Chrominance amplitude should be 285.7 mV ±2.86 mV and the bottom of the chrominance packet should be even with the gray level.

c. Adjust—R958 (Chrominance Gain) for 285.7 mV ±2.86 mV.

NOTE

Adjustments performed in Steps 7 through 10 interact. Repeat if necessary.

11. Check Black Burst Setup Level

a. Push in the Full Field Ref pushbutton and display the BLACK BURST signal on the 1480.

b. Check—Setup level should be 53.57 mV ±3.57 mV.

12. Check Black Burst Timing

a. Check—Refer to Fig. 4-3 for timing details.

13. Check/Adjust Subcarrier Phase (C865, L863)

a. Connect the 1410 Mainframe Subcarrier output to the vectorscope CW Ext ϕ Ref input. Connect the other Ext ϕ Ref input to CH B through the 10X attenuator pad. Connect the SPG1 or SPG2 BLACK BURST signal output to CH A. Display CH A and CH B. See Fig. 4-4.

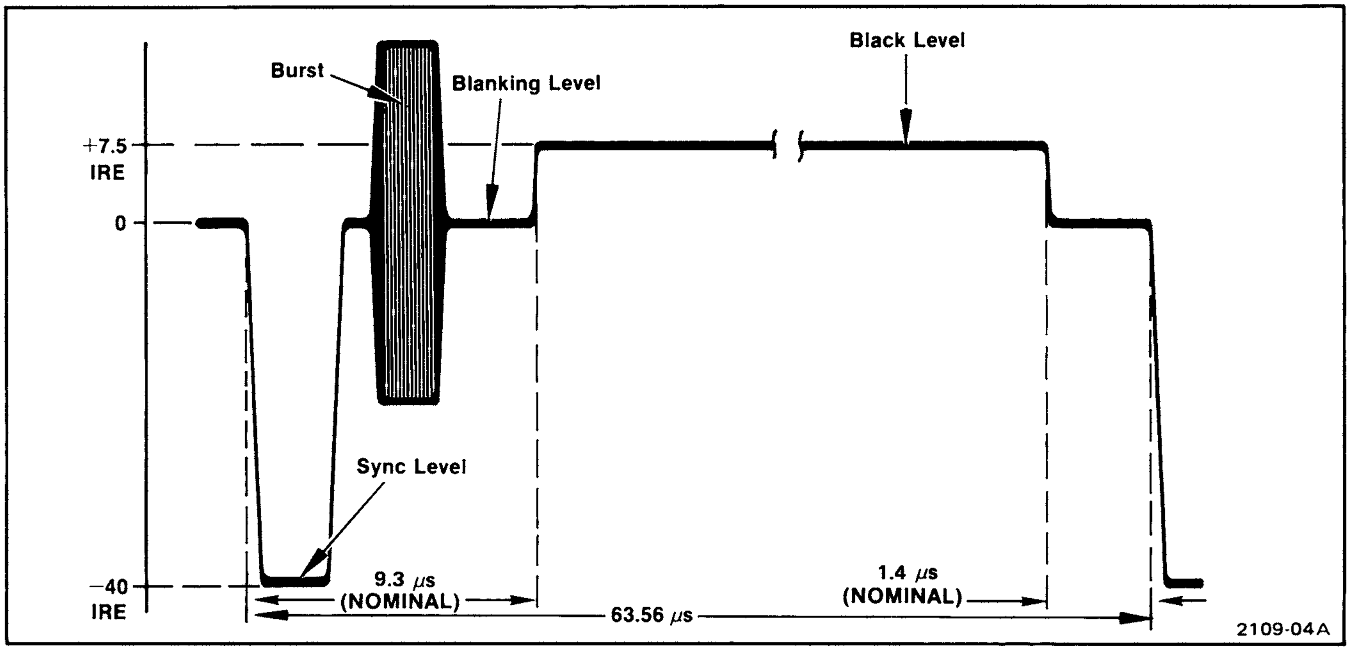


Fig. 4-3. The Black Burst Signal.

b. Check—VIRS subcarrier phase is within 0.5° of the SPG1 or SPG2 burst phase.

c. Adjust—C865 and L863 (Subcarrier Phase) to match SPG1 or SPG2 burst phase with the 1410 subcarrier phase.

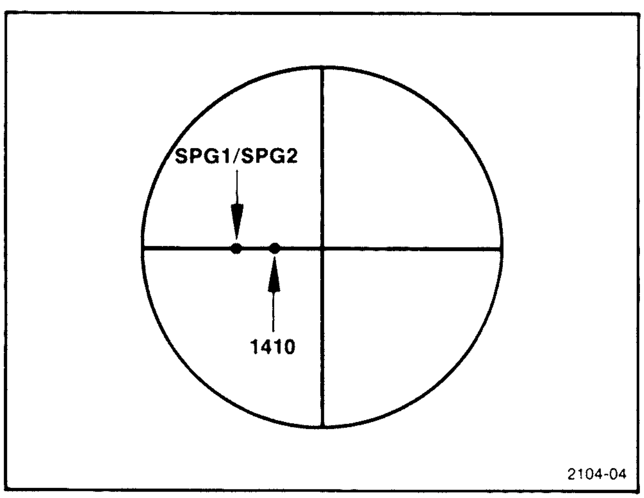


Fig. 4-4. Subcarrier phase adjustment illustration.

14. Check VIRS Line and Field Timing

a. Push in the VIRS pushbutton and set the 1480 for dig line selection.

b. Check—P858 selects proper fields: 1, 2, or both.

c. Check—P857 selects Line 18 or Line 19.

15. Check VIRS Timing

a. Display the FULL FIELD REF signal on the 1480.

b. Check—Refer to Fig. 4-5 for timing details.

16. Check Isolation

a. Note the VIRS amplitude on the 1480 display and short the opposite output pins together.

b. Check—Change in output should not exceed 1%.

c. Reverse connections in step a and repeat step b.

d. Connect the Test Oscilloscope to one pair of output connectors through a 75 Ω in-line terminator.

e. Connect the Sine-wave Generator to the other pair of output connectors through a 75 Ω in-line terminator. Set the Sine-wave Generator frequency to 3.58 MHz.

f. Check—The observed output should be −40 dB as the generator amplitude is varied from 0.5 V to 4 V (5 mV to 40 mV). Reverse output connections and repeat check.

17. Check Return Loss

a. Connect the Return Loss Bridge to the Test Oscilloscope Differential Comparator. Set the Differential Comparator for differential measurements.

b. Connect the Sine-wave Generator output through a "T" connector to the Return Loss Bridge input (see the Return Loss Bridge instruction manual) and to the Test Oscilloscope Vertical Amplifier plug-in.

c. Set the Test Oscilloscope for alternate channel viewing.

d. Set the Sine-wave Generator frequency controls for 5 MHz output.

e. Remove the 75 Ω terminator from the Return Loss Bridge Unknown arm.

f. Set the Sine-wave Generator Amplitude control for 500 mV output as monitored on the Test Oscilloscope.

g. Connect the Return Loss Bridge Unknown arm to the SPG1 or SPG2 VIRS output connector.

h. Check—Amplitude should not exceed 16 mV (30 dB return loss) as frequency is varied from 50 kHz to 5 MHz. Maintain constant sine-wave amplitude as monitored on the Test Oscilloscope Vertical Amplifier channel.

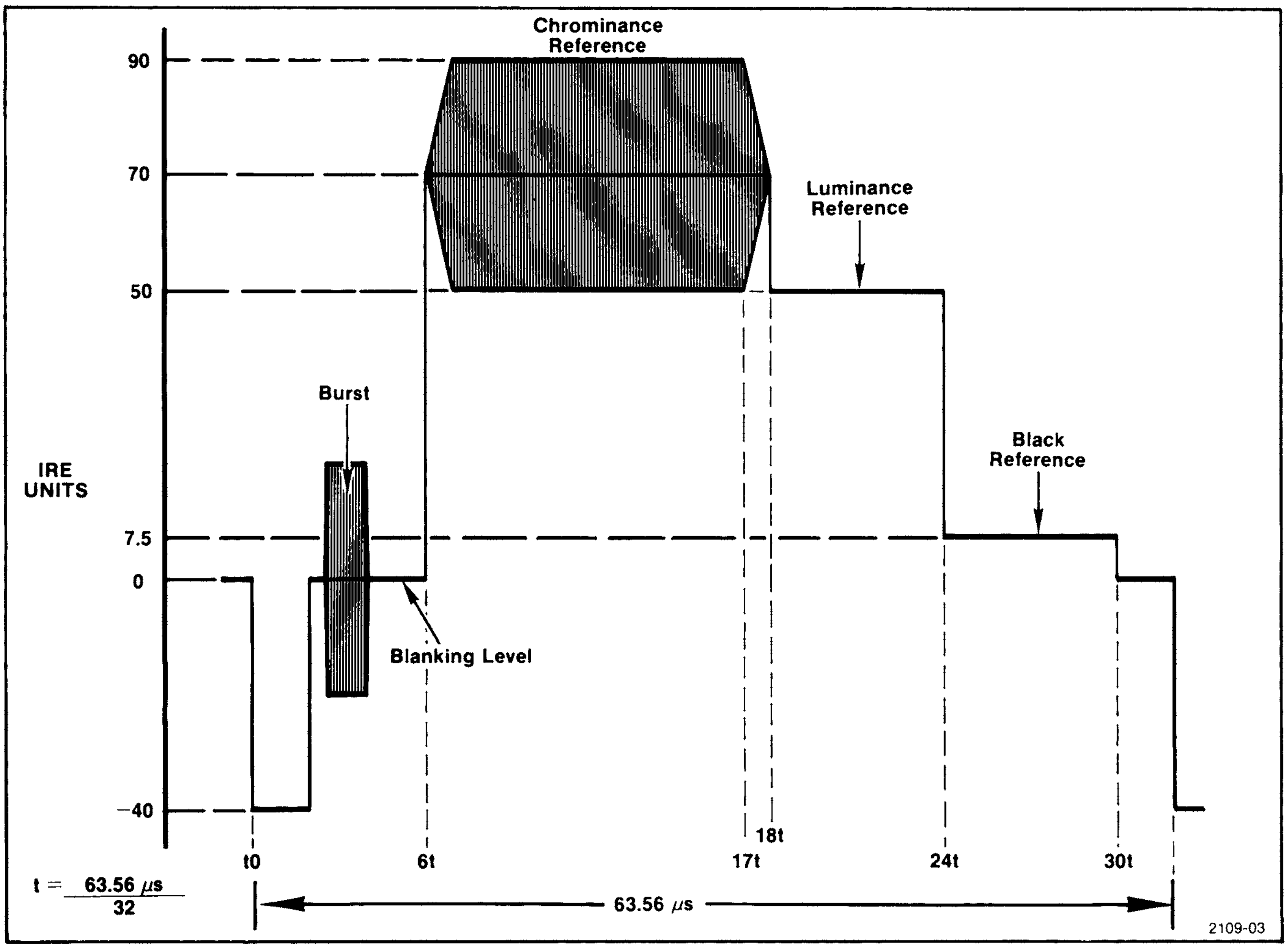


Fig. 4-5. The Vertical Interval Reference Signal.

THEORY OF OPERATION

This section is divided into two parts. First is a basic overview of instrument operation that describes circuit relationships and signal flow as illustrated by the Block Diagram. Second is a more detailed discussion of each of the circuit diagrams.

The circuit diagrams are blocked off according to circuit function. These circuit block titles are used as indices to the circuit diagram discussion.

The Block Diagram and circuit diagrams are located on fold-out pages at the rear of the manual. Refer to the appropriate diagram when reading this discussion.

Block Diagram Description

The heart of the SPG1 or SPG2 NTSC SYNC GENERATOR module is a 40-pin MOSLSI integrated circuit sync generator. This IC (found on the Sync Timing board A20, Diagrams 1a and 1b) is driven by a 640H (10.0699 MHz) oscillator and counts out sync and timing signals of the proper time and duration for operation of the rest of the 1410 system.

Oscillator frequency accuracy is maintained by comparing the leading edge of horizontal sync as generated by the sync generator IC to subcarrier phase. The subcarrier used can be either that generated in the 1410 Subcarrier Oscillator, an external subcarrier source, or an external source of composite video (in the SPG2 GEN LOCK mode). The phase comparison takes place on the Sync Lock board (A21) (see Diagrams 2a and 2b.)

Circuits on the Sync Lock (A21) board maintain the subcarrier to horizontal phase relationship and route reset information to the Sync Timing board (A20). In addition, noisy signals, or signals with sync and subcarrier not locked, or conditions where horizontal lock has not taken place are detected and the proper command routed to the Generator Logic board (A22) to switch the SPG1 or SPG2 to INTERNAL mode.

The Generator Logic board (A22) contains the logic circuits that enable the SPG1 and SPG2 to react to the various front-panel switching commands. Outputs from A22 include drives for the front-panel LED indicators as well as enable/disable commands that cause the SPG1 or SPG2 to conform to existing conditions of front-panel switch positions and the presence or absence of external signals.

The Subcarrier Lock board (A23) is present only in the SPG2 module. Circuits on this board accept composite video from an external source and generate a control voltage for the 1410 subcarrier oscillator, a control level for the Sync Lock board that indicates a locked or unlocked subcarrier condition, and composite sync stripped from the incoming composite video signal.

The Pulse Output board (A24) accepts the sync and blanking signals from the Sync Timing board (A20) and shapes them for output. Each signal passes through one-half of a Tektronix-manufactured integrated circuit amplifier. Each amplifier provides the necessary drive for the output connectors.

The VIRS/Black Burst board (A25) uses the timing signals generated on the Sync Timing board (A20) to address a Programmable Read Only Memory which then produces the timing signals for the VIR Signal.

Subcarrier is modulated by timing signals generated on A25 then combined with luminance signals to form the VIR Signal at the output amplifier.

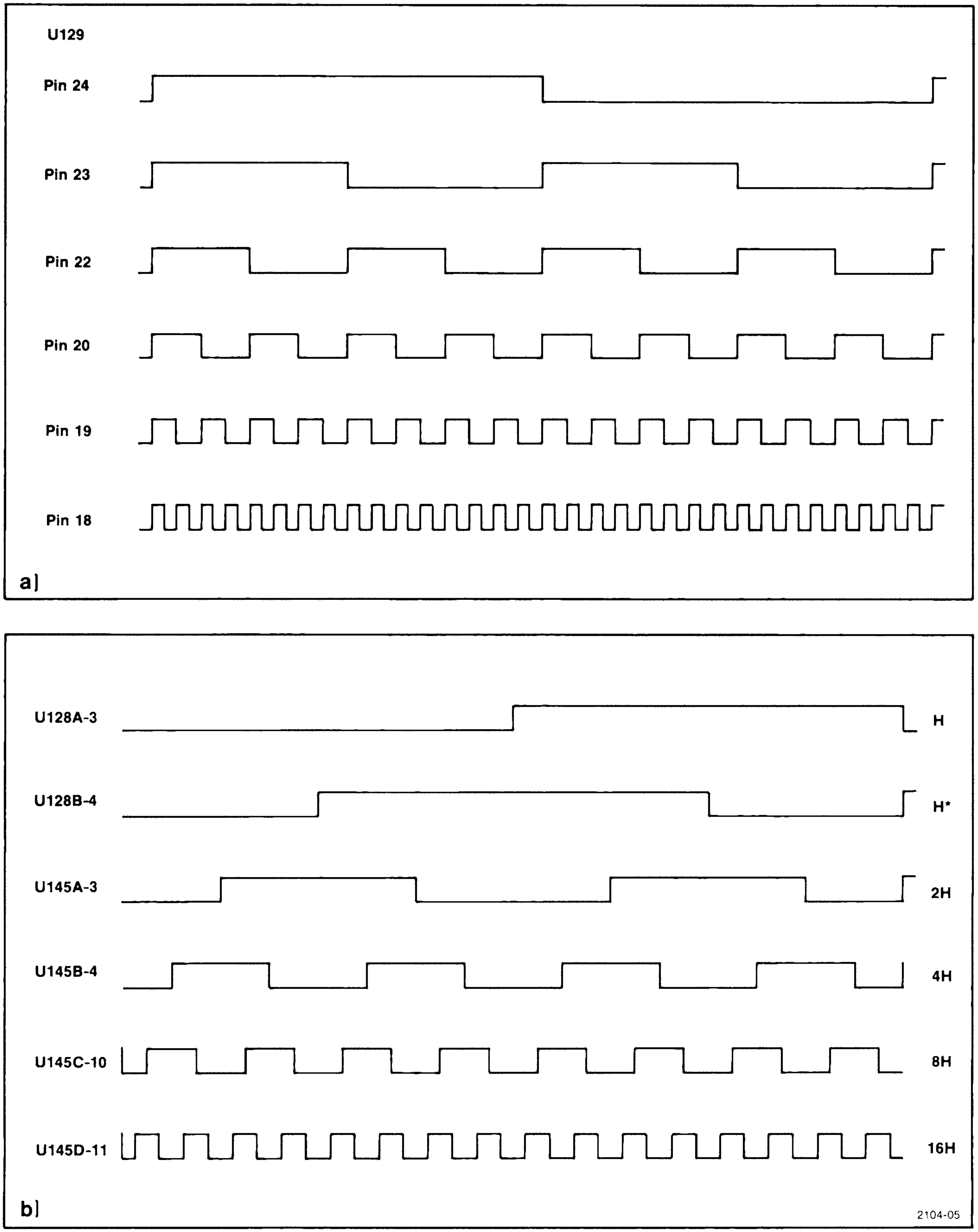


Fig. 5-1. H Timing diagram.

CIRCUIT DESCRIPTION

DIAGRAM ⟨1⟩ a & ⟨1⟩ b SYNC TIMING

Circuits on Diagrams 1a and 1b form the heart of the generator system. U129, a MOS/LSI circuit, generates the timing signals required for performance of the total system. U129 is clocked by a 5 MHz (320H), 2 phase pulse, which is derived from a 10 MHz (640H) oscillator. The outputs from U129 are either routed directly to the Interface board, or processed in one manner or another to produce necessary pulses.

DIAGRAM ⟨1⟩ a

10 MHz Oscillator

Q157 is the active component of a Pierce Oscillator operating at 10 MHz. The frequency is determined by C159, C152, and L159, with frequency tuning controlled by C159. CR154 provides fine tuning of the oscillator frequency. The setting of C159 determines pull-in range of the oscillator.

Clock Drivers

The 10 MHz clock is divided by 2 and split into two phases by U152B and applied to two cascaded push-pull amplifiers. They amplify the two-phase 320H clock pulse required by U129. The TTL-amplitude signals at the outputs of U152B are stepped up to nearly 30 volts at the clock inputs (pins 13 and 14) of U129.

Sync Generator and Output Buffers

U129 is a MOS/LSI circuit that accepts the 320H clock pulses and generates timing pulses as required for operation of the rest of the system.

The 320H clock is counted down to 64H in U129. The 64H signal is then synchronously counted down (in U129) to H. Each interval of the countdown from 64H to H is an individual output of U129 (pins 17, 18, 19, 20, 22, 23, 24). The 64H derivatives from 32H to H are applied to a series of exclusive-or gates prior to the buffer amplifiers. The exclusive-or gates modify the sync generator outputs into a Gray Code reflection of the original signals. See H Timing Diagram, Fig. 5-1.

Each of the timing signals from U129 is applied to a buffer amplifier that reduces the signal amplitude, making it compatible with the TTL logic that follows.

The outputs of the Output Buffers are applied to the Interface board for routing to the rest of the system.

Burst Timing

The positive-going leading edge of the burst gate start pulse from U129 pin 32 clocks U126A. U126A is one-half of a dual monostable multivibrator with variable output pulse width as controlled by the external timing components C126, R117, and R119. Burst Delay control R119 is adjusted for breezeway width.

The trailing edge of the pulse from U126A pin 4 clocks U126B, the second half of the dual monostable multivibrator package, C127, R127, and R128 (the Burst Width control) are the external timing components for this device. R128 is adjusted for burst width. The output from U126B pin 12 is applied to the Interface board through U112A, which is an on-off gate controlled by the burst gate disable command from the Generator Logic board A22 (Diagram 3).

H Drive Timing

The H Drive signal on Interface board pin 7 is derived from one of two selectable sources. First, with P103 pins 2 and 3 shorted together, directly from sync generator circuit U129. Second, with P102 pins 2 and 3 shorted together, from D flipflop U102A. U102A receives its clock from the Variable H Blanking Start multivibrator U110B on Diagram 16. The time that pulse is generated depends on the setting of the H Blanking Start. The output of U102A goes high with the H Blanking Start clock pulse, beginning the variable H drive pulse. U102A's clear is set low at the end of H drive from U129, switching the output low again, ending the variable H drive pulse. See H Drive Timing Diagram Fig. 5-2.

Phasing Pulse Control

U115A generates a pulse of the type normally used in PAL television systems to regulate subcarrier phase on alternate horizontal lines. The output can be either a pulse or a square wave. H/2 is a square wave with its starting point at H Blanking start. This signal drives U115A D input, determining the output phase of U115A. U115A is clocked by a signal from U129 pin 24 that is coincident with line sync. If a square-wave is desired, P112 is open, leaving U115A's preset tied high. If a pulse output is desired, P112 connects U115A's preset to the H Drive pulse and U115A is reset at the end of H drive.

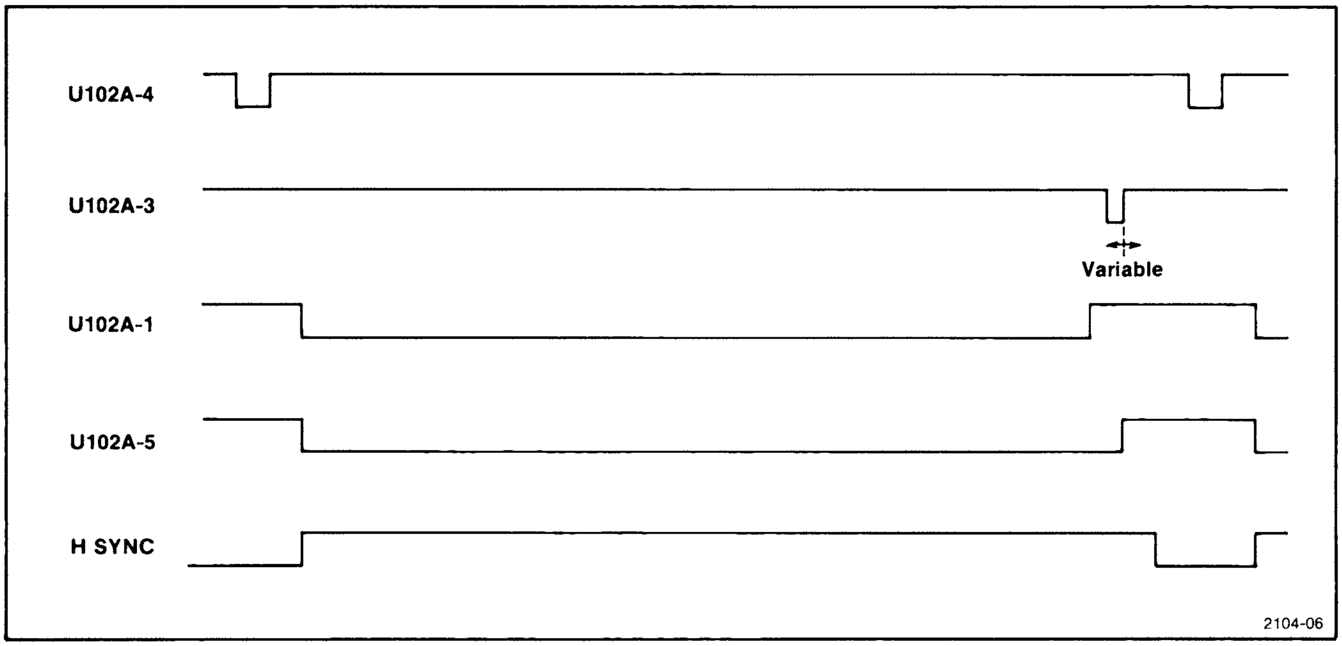


Fig. 5-2. H Drive Timing diagram.

DIAGRAM ⟨1⟩ b

Color Bar Timing

This circuit generates a series of pulses related to horizontal line timing used by the Color Bar Generator module TSG1 to time the individual bars sequence.

A two-stage 6-bit binary counter (U151 and U142) counts down from the 640H clock input to provide proper timing. The output timing is altered by command from the TSG1 when EIA color bars are desired.

U151 and U142 are data-loaded to counts determined by U141B and U141D, and U132A and U132B. In the full-field mode, the data load is a count of 63. The counter then divides by 65, resulting in a time between output pulses of 6.5 μs.

In the EIA mode, interface line 47 is set to ground by the EIA switch in the TSG1 module. U141C and U146B alter the data load 3/4 of the way through the field. For the first 3/4 of the field, the counter is loaded to a count of 53. The counter divides by 75, resulting in 7.5 μs bar widths. For the last 1/4 of the field the data load is changed to 34, the counter divides by 94, and the −I, W, and Q bars are generated. The Q output of U146B is also used by the TSG1 module to time the split-field displays. P144 determines the timing, either 1/2 field or 3/4, 1/4 field split.

The counter output is combined in U141A with a signal derived from horizontal blanking and routed to the TSG1 module via the Interface board. This output is also fed back to the counter load inputs to synchronize the count.

U148B and U146A form a timing circuit that determines the point on the line that the color bars begin. The time is controlled by R149, the Color Bars Horizontal Shift control.

Vertical Reset

This circuit locks the vertical counter in U129 to field 1 of the external reference signal in EXTERNAL and GEN LOCK modes.

Interface line 48 carries the field 1 identification pulse (field 1, line 6) from the Vertical Sync Detector on Generator Logic board A22 to the data input of U152A. In the fast Lock mode, U164A delays the pulse time by about 500 μs as controlled by Vertical Phasing control R169. U164B sets a pulse width of about 40 μs. The vertical reset pulse amplitude is increased to 15 V by U159B and is applied to U129 to reset the vertical counter. R169 advances or delays the vertical counter reset by one line.

Vertical Advance Delay

This circuit allows slower lock of the vertical counter in U129 to the external reference signal than the Vertical Reset circuit discussed previously.

The vertical reset pulse from U164B triggers the lock pulse in the slow lock mode. The vertical reset pulse is and'ed in U167C with a low output from U166B and gated through U167B to U159B and U129 under locked conditions. This ensures sustained lock of the U129 vertical counter to the external reference.

At the end of the V drive pulse, U162B generates a one-half-line timing pulse which passes down shift registers U161 and U160. Points along these shift registers are picked off to perform the desired timing functions.

U165C generates two clock pulses for U166B that cause U166B to generate an output between those two clock pulses. The output is of known polarity because of the V/2 preset. The output from U166B enables U167C to pass the vertical preset pulse from U164B during that output time. U166B Q output sets U166A D input high during that time so that if the vertical preset pulse is present, U166A Q output goes high indicating vertical lock.

U165B and D are used to generate a V/2 signal with edges coincident with normal vertical preset. U162A is clocked by incoming vertical preset so that if the vertical counter in U129 is not locked to incoming vertical preset, the output of U162A will enable U163 or U163D. Which gate is enabled, U163C or U163D, depends on relative position of the output of U165B and D compared with incoming vertical preset. This allows the vertical counter to be reset one line early (U163C or one line late (U163D) through gates U167A, U167D, and U167B, to bring the vertical counter into lock with the incoming signal.

When lock is acquired, U166A output is high and lock is maintained by the state of U166B providing a low input to U167C, allowing the vertical reset pulse to pass through to U159B.

Horizontal Phasing

U106 is loaded 16 μs before horizontal sync and enabled 4 μs before horizontal sync by commands from programmable read-only memory (PROM) U107. U129 supplies the 64H clock pulse. After a number of clock pulses, determined by the setting of S109, U106 generates a carry output pulse that is carried by interface line 3 to the Variable Delay circuit on Sync Lock board A21 (Diagram 2b). The timing of the load and enable commands permits delay of the carry output pulse for a time period extending from 4 μs before horizontal sync to 10 μs after horizontal sync.

Variable Horizontal Blanking

The two sections of U110, a dual monostable multivibrator, generate start and stop pulses for U102B, the Variable Horizontal Blanking generator. U110B initiates the blanking pulse, switching on the leading edge of the waveform from U107 pin 6. Duration of the start pulse is determined by the setting of U116 (H Blanking Start). U110A terminates the blanking pulse, switching on the trailing edge of the waveform from U107 pin 6. Duration of the stop pulse is determined by the setting of U115 (H Blanking Stop). The start pulse clocks U102B with its trailing edge, and the stop pulse trailing edge toggles U102B to terminate the blanking pulse. The time between trailing edges of the start and stop pulses determines the duration of the Variable Horizontal Blanking pulse. The preset pulse at U102B pin 10 ensures the right polarity of U102B's Q output.

The blanking pulse is routed to P110, where it can be selected to become part of the composite blanking signal on interface line 10.

Variable Vertical Blanking

The leading edge of the V blanking waveform from U129 triggers U148A. U148A's output pulse duration is determined by R148, the Vertical Blanking Stop control. U148A's output sets U159B, and clears U159B at the end of its one-shot time constant. When U159B is cleared, its D input is high. If the H rate clock is present at the time, the variable vertical blanking pulse is generated. U159B output is applied to P111 where it can be selected to become part of the composite blanking signal on interface line 10.

DIAGRAMS ⟨2⟩ a & ⟨2⟩ b
SYNC LOCK

Circuits on Diagrams 2a and 2b accept sync and subcarrier from the selected sources, either internal or external, and generate the proper locking signals to phase-lock the Clock Oscillator on Sync Timing board A20 (Diagram 1a). The Clock Oscillator may be phase-locked to external line sync or subcarrier.

DIAGRAM ⟨2⟩ a

Subcarrier X2 Multiplier

Subcarrier to the other modules can be either locked to the 1410 3.58 MHz oscillator or is variable by turning the SUBCARRIER PHASE control. Refer to P339 on Diagram 2a. Note that the subcarrier applied to the Sync Lock board, A21, comes from either of two sources. With pin 1 of the connector connected to pin 1 of P339 on the circuit board, subcarrier reference comes from the SUBCARRIER PHASE control through the Pulse Output board, A24. With the connector reversed, subcarrier comes from the 1410 Subcarrier Input board, A13.

The outputs of U299A and U299D are at the subcarrier rate, but only one-fourth of a subcarrier cycle in duration. The in-phase output (U299A) is applied to U249B in Subcarrier/Horizontal Phasing circuit.

The outputs of the two pulse-narrowing networks are applied to U299C, which acts as a negative-input "or" gate. The output of U299C is twice the subcarrier rate with a 50% duty cycle and becomes the clock pulse for the divide-by-455 Horizontal Counter.

Horizontal Counter

The Horizontal Counter divides the twice-subcarrier-rate signal from the Subcarrier X2 Multiplier circuit by 455, generating an accurate H-rate signal at count 2048.

U289, U279, and U259 are loaded to a count of 1,592 by a command from U259's carry output. Following the load command, the counter is clocked by the 2X subcarrier signal from a count of 1,592 to 2048 dividing that clock by 455. In the internal mode of operation, the count to which the counters are loaded is never changed.

In the external mode of operation, the count can be altered by inputs from the Counter Reset Logic circuit. In the Slow-Slow Lock mode, the A and B inputs of U289 are loaded to add or subtract one count from the total if the Sync Phase Comparator circuit senses that the Counter H output is not in phase with input line sync. In the normal lock mode, horizontal sync from Generator Logic board A22 (Diagram 3) is used to reset the counter immediately through U200B, U249A and U255C.

Sync Phase Comparator

Horizontal sync, through U334A, switches diode switch CR270-CR271 (CR271 is normally conducting). Q260 generates a positive-going ramp that is clamped by Q262. At the falling edge of the signal on Interface line 87, the diode switch reverts to its normal condition, and the output of Q160 ramps back to ground.

The Q_A output of U259, which is an H-rate squarewave, is fed back to U285A. U285A and U285B time a sampling pulse (timing controlled by Preset Center control R276) to be in the center of the ramp that is generated by Q260. Q261 is turned off, turning Q252 on, allowing the ramp level at that time to be stored by memory capacitor C252. The memory level is applied through voltage follower U254A to quad comparator U205.

Each portion of U205 is preset by a section of a voltage divider to switch at some level of the sampled ramp voltage. When one of the comparators switches, the counter is reset as described earlier.

If the sample occurs on the falling portion of the ramp (after sync has ended), U240B and Q217 set the level on one input of U275C to ensure that the counter is shifted to allow the comparators to operate.

Counter Reset Logic

In the normal lock mode (P228 jumper connected to pins 2 and 3), a phase shift (sensed by the Sync Phase Comparator circuit) of sufficient amount to switch one of the reset portions of the comparator, feeds back to the clear input of U200B, enabling U200B to switch. U200B switches at the leading edge of the next horizontal sync pulse, presetting the Q output of U249A high. The high output from U249A loads the counter to the correct count (1,598). The Sync Phase Comparator output also disables the slow-slow lock loop with a low applied to U275B from U224A.

If the phase shift sensed by the Sync Phase Comparator is not sufficient to switch the reset portions of the comparator, either the retard or advance portion will act. The retard portion of the comparator operates when the Sync Phase Comparator senses that the counter output is leading the horizontal sync on interface line 87. In order to correct this lead, the counter must divide by 456. U255B pin 6 and U255A pin 3 are set low, resulting in a high level at U289 pin 4, and a low level at U289 pin 3.

At the next carry output from U259, the counter is loaded to a count of 1,591, allowing division by 456. U220B then triggers, switching the state of the counter back to divide by 455. If at the end of one-shot (U220B) time the phasing is still retarded, the same sequence is repeated.

If the Sync Phase Comparator senses that the counter is lagging horizontal sync, the count is similarly changed to 454 until the counter catches up.

In the slow-slow lock mode (P228 jumper connected to pins 1 and 2), U200B is always inhibited by the low clear command from U245D. The reset portions of comparator U205 now switch U275C, which in turn causes the count to be changed by one until an in-phase situation is regained. The retard and advance portions of the comparator operate as in the normal mode of operation. In the INTERNAL mode, the counter advance and retard functions are switched off through U255 pins 5 and 2, and the counter is preset through U255 pin 9.

Subcarrier/Horizontal Phasing

H/2 pulse from Sync Timing board A20 triggers U229B. U249B data input receives subcarrier-rate pulses from U299A and is clocked by the end of U229B one-shot time, timed by R219, the SCH Phase control. If U249B data input is low, at the time of the clock, the Q output goes low. When H/2 goes low, the Q output is preset high, triggering U220A, which in turn resets the horizontal counter in U129 on Sync Timing board A20.

Circuits on Diagram 2b sense the absence of burst and apply a low inhibit to U245C in monochrome conditions. This mode inhibits horizontal reset of the counter in U129 on Sync Timing board A20.

U220A is inhibited from generating a horizontal reset pulse when circuits on the Generator Logic board indicate absence of either horizontal or vertical lock and apply a low clear command via interface line 83.

Timing Jitter Detector

In the presence of an intermittently noisy signal or an unlocked sync-subcarrier condition, the subcarrier counter is continuously preset, causing U275A to pump current into memory cap C251 through Q284. If the noise persists, U254B's output becomes positive enough to gate a command through U224D that switches circuits on the Generator Logic board to switch to internal mode (if P224 is connected).

If sync and subcarrier are expected to be unlocked, P324 should be connected. This connection will cause the generator to lock to sync under sync-subcarrier unlocked conditions.

DIAGRAM ⟨2⟩ b

The circuits on Diagram 2b provide proper subcarrier to sync lock timing and inform Generator Logic board A22 when H lock is unsuccessful, allowing the SPG1 or SPG2 to switch to internal operation. The output from phase lock amplifier U284A keeps the 1410 subcarrier oscillator at the correct frequency.

Sync-Subcarrier Lock

The state of U334D's output determines whether the SPG1 or SPG2 locks to subcarrier or sync. With the instrument set for external operation and sync lock, the Q output of U240A is low, U334D pin 10 is high because of external operation, and U334D pin 11 is high because of the low output of U240A. The low output at U334D pin 9 inhibits U229A and enables U330D.

A horizontal-rate square-wave from U259 (Diagram 2a) is gated through U330D and clocks U325B. U325B enables ramp generator Q315 and a near-square ramp is applied to the emitter of Q304.

At the same time that the ramp is being started, H sync from Sync Timing board A20 clocks U200A. U200A output trailing edge clocks U325A. U325A generates a 500 ns sample pulse that occurs some time during the leading edge of Q315's ramp as determined by the HORIZ DELAY control. The sample pulse turns off Q312, which turns on Q304 and allows the ramp level at that time to be stored in memory capacitor C295.

Voltage follower U284B applies the level at C295 to phase-lock amplifier U284A, and to the H Unlock Detector circuit. U284A compares the output of U284B with its reference at pin 3 and applies correction voltage to the 640H oscillator via Interface line 55.

If the 640H oscillator is unlocked, the ramp and the sample pulse are no longer coincident. The output of U284B still follows whatever level appears at C295. A positive excursion by U284B output turns on Q294 via C298 and CR304. Q294 conduction turns on Q306, which switches the state of U324F output from high to low, signaling Generator Logic board A22 to indicate loss of sync and to switch to the internal mode.

At the same time, Q330 is turned off, turning on Q305. This places R296 (and R293 if slow-lock is selected) in parallel with R298, increasing the ac gain of U284A.

Q294 is held on by C307, holding Q306 on until the output of U284B settles down after re-acquiring lock. This ensures rapid phase-lock of the 640H oscillator.

With the instrument set for external operation and subcarrier lock, U240A pin 5 is high, causing U334D to enable U229A and disable U330D. U229A is clocked by H-rate signals counted down from subcarrier. The ramp is then referenced to subcarrier instead of sync.

Should the incoming subcarrier by lost, circuits on Generator Logic board A22 change the state of U240A data input. Another circuit on A22 applies a pulse via Interface line 57 that occurs at the sixth serration of the vertical pulse. That clock changes the state of U334D and switches back to sync lock. Remember that this action only takes place when the instrument is in subcarrier lock.

U330B, U334C, and U330C inhibit the sample pulse generator during the time that sync is missing.

With the instrument in internal mode, U334D selects subcarrier lock at all times.

DIAGRAM 3

VERTICAL SYNC AND GENERATOR LOGIC

Circuits on Diagram 3 provide the necessary synchronization switching functions and the logic required to alter the operation and front-panel indications of the SPG1 or SPG2 to conform to existing conditions.

Mode Switching

This circuit has four dc output lines (designated L, $\overline{L}$, K, and $\overline{K}$) that change logic levels as determined by the front-panel setting.

P374 and P366 enable or disable gen lock operation. The jumper should be on P374 if Subcarrier Lock board A23 is installed (SPG2), and on P366 if A23 is not installed (SPG1).

P365 connects the line K output to U386B when the HORIZONTAL LOCK switch is in the SUBCARRIER position. U386B pin 5 is low only in EXTERNAL mode and SUBCARRIER lock. This condition causes the SPG1 or SPG2 to lock internal sync to external subcarrier but not light the front-panel INTERNAL LED.

Sync Switching

The Sync Switching circuit selects sync from external, or in the case of SPG2, gen lock inputs and provides a starting pulse for the Sync Phase Comparator ramp generator on Sync Lock board A21 (see Diagram 2a).

U420B or U420D is enabled, depending on the Mode Switching circuit outputs. In the EXTERNAL mode, $\overline{K}$ is high, enabling U420D and allowing external sync from the rear-panel COMP SYNC input to pass. U420C and U420A gate the sync through to the clock input of U426. U426 generates a positive-going pulse about 40 μs in width, locking out the 24 pulses in the vertical interval.

In the GEN LOCK mode (SPG2 only), $\overline{L}$ is high and $\overline{K}$ is low, enabling U420B and passing sync from the Sync Separator circuit on Subcarrier Lock board A23. U426 operates in the same manner as in EXTERNAL.

A second output from U420A routes sync to Interface line 54 and to the Vertical Sync Detector.

Vertical Sync Detector

The negative-going sync pulses from U420A switch Q406 off as they arrive. During normal line sync, the line sync period is short enough that the change developed on C405 is not sufficient to turn Q405 on. During the vertical pulse time, however, the long vertical pulses do develop enough charge on C405 to turn Q408 on, generating a positive-going pulse for each of the six serrated vertical pulses. These pulses are applied to U400B as a clock, and to a pulse delay network, U406B, R402, C397, and U406F.

When U400B is clocked, a positive-going pulse longer than one-half line in duration is applied to U401A from U406F following the enable input and starts down the register.

Each of the following clock pulses has a similar effect on U400B and U401. U400B is not allowed to clear U401, and each time U401 is clocked the pulse is stepped one position along the register.

At the sixth clock pulse (corresponding to the sixth serrated vertical pulse), U401 output is picked off and routed to U406D and to sync present detector U400A. When U400A is clocked, its Q output goes high and Q low. The time constant is greater than one field in duration so the outputs remain in the same state as long as U401 generates a clock each field.

U401 output is also applied to U400B timing circuit via CR396, terminating U400B output and clearing U401.

Switching Logic

The outputs from the Switching Logic circuit are logic levels, with the exception of the vertical preset lines 48 and 57. The vertical preset pulses, however, are not present at lines 48 and 57 in INTERNAL mode since any external input is locked out in the Sync Switching circuit.

INTERNAL Operation. Line 52 (burst lock disable) is set low at all times in the INTERNAL mode because of output L from the Mode Switching circuit. This line goes to the Phase Lock Amplifier on Subcarrier Lock board A23, Diagram 4b.

External subcarrier line 56 is high at all times in the INTERNAL mode because of output K from the Mode Switching circuit disabling the four-input NAND gate formed by U389A, U389D, and U388A. This line goes to the Internal/External Subcarrier switch on Subcarrier Input board A13 in the 1410. See 1410 Diagram 3.

Line 14 is the front-panel SYNC indicator drive. The mode of indication is selectable by positioning P387. In the sync absent position of P387, U385D is bypassed. The SYNC indicator is always off in the INTERNAL mode. P449 pin 3 routes a LED drive output, inverted from that on line 14, to the 1410 rear-panel REMOVE connector for use in remote indicators if desired.

Line 46 routes a command to the Sync Lock Logic circuit on Sync Lock board A21 (Diagram 2b) when burst is missing in the GEN LOCK mode. In the INTERNAL mode, line 46 is always high.

Line 1 drives the front-panel SUBCARRIER indicator. The mode of indication is reversable, depending upon the position of P383. In the subcarrier absent position of P383, U385A is bypassed. The SUBCARRIER LED is always off in the INTERNAL mode. P449 pin 1 routes a LED drive output, inverted from that on line 1, to the 1410 rear-panel REMOTE connector for use in remote indicators if desired.

Line 87 routes a signal from U426 in the Sync Switching circuit to the Sync Lock board A21 (Diagram 2a) for timing reference in EXTERNAL or GEN LOCK modes. In the INTERNAL mode, line 87 is always low.

Line 32 routes a video disable command, if desired, to all module locations. In the INTERNAL mode, line 32 is always low. In EXTERNAL or GEN LOCK modes, a high output on line 32 can disable video output upon loss of lock. With P380 in the "can" position, video is disabled upon loss of lock. With P380 in the "can't" position, line 32 is always low and can't disable video.

Line 4, burst gate disable, is always low in the INTERNAL mode, or when P380 is in the "can't" position. Line 4 goes to the Burst Gate Generator circuit on Sync Timing board A20, Diagram 1a. A high level on line 4 inhibits the burst gate.

Line 31 can disable the chrominance portions of composite video signals upon loss of lock, if P382 is positioned for it. In the INTERNAL mode, or with P382 in the "can't" position, line 31 is always low. A high on line 31 inhibits chrominance portions of signals in some modules.

Line 15 is the front-panel INTERNAL indicator drive. In the INTERNAL mode, or under some conditions of loss of lock, line 15 is low. P449 pin 2 is an external LED drive, inverted from that on line 15.

Line 85 routes a command level to the Sync Lock Logic circuit on Sync Lock board A21, Diagram 2a. In the INTERNAL mode, or under some loss of lock conditions, line 85 is low.

In the EXTERNAL mode, the Mode Switching outputs are altered to change the switching commands from the Sync Switching circuit.

With external sync present in the EXTERNAL mode, U400A pin 6 is high and pin 7 is low. U396A output is high if external subcarrier is not present, and low if external subcarrier is present. U406A output is low if U410A senses both H and V lock. U386D's output is high, and U388D's output is high, setting up the logic conditions for EXTERNAL operation.

The K output from the Mode Switching circuit is high in the EXTERNAL mode, allowing external sync from the 1410 rear-panel input to pass to the Vertical Sync Detector circuit. The high K level is also applied to U398B.

U398B also has high inputs from U386B and from Interface line 59 if external subcarrier is present or from R398 if P398 is in the Not Needed position. The Not Needed position of P398 eliminates the requirement for having external subcarrier present in the EXTERNAL mode.

U399D, seeing a low level at its input, applies a high level to the front-panel INTERNAL indicator, turning it off. U389C, sensing the high levels from U399D and U388D, applies a high level to line 85 to enable the Sync Phase Comparator on Sync Lock board A21, Diagram 2a. The high from U389C also enables U406D to pass vertical preset pulses to line 48. The rest of the logic outputs operate similarly to the INTERNAL mode until one of the external signals disappears.

If the external sync is lost, U410A, U426A, and U400A all switch states. U386A disables video outputs, if P380 is in the "can" position. U398A's output switches high, setting line 85 low and turning on the front-panel INTERNAL indicator. U389B senses two low inputs and turns on the front-panel SYNC indicator, assuming P387 is in the Sync Absent position.

If external subcarrier is lost, line 59 is low, causing U396A output to be low. That turns on the front-panel SUBCARRIER indicator, assuming P383 is in the Subc Absent position. The low on line 59 also causes U398B to turn on the front-panel INTERNAL indicator and switch line 85 low.

The HORIZONTAL LOCK switch does not affect circuits on this diagram as long as external sync is present and P365 is in the "needed" position.

If the HORIZONTAL LOCK switch is in the SUBCARRIER position, and P365 is in the "not needed" position, the low K output causes U386B to maintain the Switching Logic circuit in the external mode.

In the SPG2 GEN LOCK mode, sync arrives via line 53 from Subcarrier Lock board A23, and the subcarrier lock signal arrives via line 51, again from A23. The Switching Logic circuit reacts to these inputs similarly to the EXTERNAL mode.

DIAGRAM ⟨4⟩a and ⟨4⟩b SUBCARRIER LOCK

Circuits on Diagrams 4a and 4b receive composite video from an external source, and generate a control voltage for the Subcarrier Oscillator in the 1410, a lock signal for Sync Lock board A22, and composite sync.

DIAGRAM ⟨4⟩a

Chroma Amplifier

The Chroma Amplifier consists of the Chroma Pickoff, and three operational amplifiers in series with an Automatic Gain Control (AGC) circuit.

Chroma Pickoff. C735 and L734 form a series resonant LC trap. The subcarrier components of the input signal are separated from the low-frequency components and applied to the Chroma Buffer Amplifier.

Chroma Buffer Amplifier. Q725 and Q715 form an operational amplifier with a gain of 5. The output is regulated by the AGC circuit and applied to the Limiting Amplifier.

AGC Operation. CR729 and CR736 form a gain control circuit. This circuit regulates the subcarrier signal current from the Chroma Buffer Amplifier by shunting a portion of that current through CR736 to ground.

The amount of signal current shunted to ground depends on the relative impedances of CR736 and CR729. If the input signal is large, the AGC control voltage from Diagram 4b decreases the conduction (increases the impedance) of CR729. The signal current then has a lower impedance path through CR736 and less signal current reaches the Limiting Amplifier.

If the input signal is small, the AGC control voltage decreases CR729's impedance and the signal current has a lower impedance path to the Limiting Amplifier.

Limiting Amplifier. Q718 and Q719 form an operation amplifier with the feedback resistor shunted by two diodes (CR699 and CR708). The two diodes limit the peak-to-peak signal amplitude at the amplifier output at about 1.2 volts.

Output Amplifier. Q665 and Q666 form an operational amplifier that provides adequate drive current for the demodulators. L679 (Subcarrier Phase) is adjusted to compensate for phase changes caused by the amplifiers.

Sync Stripper

U700 is a Tektronix manufactured sync stripper circuit. Composite video, from an external source, arrives at the input and composite sync is the output. If the input signal contains sound-in-syncs, the position of P690 can be selected to delete that signal.

R707 is adjusted for proper timing of the sound-in-syncs deletion. R749 is adjusted for proper sampling point on a ramp generated in U700. The proper timing of the sample ensures that noise during video time will not cause U700 to change its timing. The Sync Stripper output is routed via the 1410 Interface board to Generator Logic board A22, and through R680 to the Clamp Timing Circuit.

Clamp Timing

Negative-going composite sync from Generator Logic board A22 turns off CR680, turning off Q670 after a time set by R673 and C650. When Q670 turns off, Q686 also turns off. This all happens during back porch time so that the incoming signal burst is allowed to pass to the demodulators. Subsequent circuitry matches the 1410 subcarrier phase to the incoming burst phase. The clamp pulse from Q670 is also applied to the Burst Detector and AGC circuit on Diagram 4b.

With P685 in the Cancel position (pins 1 and 2 connected), Q686 is also off during sync time. This means that the demodulators see residual subcarrier on sync tip as well as burst. The effect on the 1410 subcarrier is to cancel the phase error due to residual subcarrier.

Demodulators

The output of the Chroma Amplifier is applied to three integrated circuit demodulators (U639, U626, and U630). U639, the In-Phase Demodulator, and U626, the Quadrature Demodulator, compare the chroma signal at their + and − signal inputs to the 1410 subcarrier signal at their + carrier inputs. The output is proportional to the phase difference between the input signals. Both operate in the same manner, but U626 receives subcarrier shifted 90° in phase by L645 and C653.

U630 receives the signal from the Chroma Amplifier at its signal inputs and + subcarrier input, and operates as a self-synchronous detector. The output is proportional to the input chrominance amplitude and is not affected by phase.

All three outputs pass through shaping filters that remove any subcarrier component and through buffer amplifiers. The buffer amplifier outputs are applied to the Phase Control, Lock Detector, Burst Detector and AGC circuits on Diagram 4b.

The clamp pulse from Q565 causes Q578 to sample the level at the output of the In-Phase Demodulator buffer amplifier during burst time. This level is fed through U619 to U639 to ensure that the buffer amplifier output is at zero volts during burst time.

DIAGRAM ⟨4⟩ b

The three demodulators outputs plus the output of the Clamp Timing circuit are applied to the inputs of the three major circuits on Diagram 4b. The Clamp Timing output and the Amplitude Detector output enable a two-transistor gate (Q550 and Q560). When Clamp Timing and Amplitude Detector outputs coincide (burst time), the gate enables the memory circuits at the inputs of the Phase Control circuit, the Lock Detector circuit, and the Burst Detector and AGC circuit.

The instantaneous voltage levels at the inputs of the three circuits are stored in memory capacitors and applied through voltage followers to the rest of the circuits.

Phase Control

The output of the In-Phase Demodulator is applied to the memory portion of the Phase Control circuit. The instantaneous level during burst time is stored in C528 by Q539 and routed through voltage follower U489B to error amplifier U489A. The level at the input of the error amplifier is inverted and amplified and applied to the Control Voltage Switching circuit. The error signal is picked off at the wiper of R456 and routed to the 1410 Subcarrier Oscillator to control the oscillator varicap.

The error amplifier output is fed back through Darlington transistor Q465 to the error amplifier input. The Darlington configuration is used so that the current demand by the feedback loop does not affect the frequency control with temperature changes. C456 rate-limits the level changes the amplifier can make.

Q469 is a band switch circuit used to change the slew-rate of the amplifier by changing the input impedance. If fast lock is desired, P459 is connected around R459. The input impedance is then R469 in parallel with R479. For slow lock, P459 is open and the amplifier input impedance is R459 and R469 in parallel with R479.

Q469 is on only when the Lock Detector circuit detects a "no-lock" condition. When the circuit is locked, the junction of R467 and R468 is at +0.6 volt and the band switch is off.

Lock Detector

The output of the Quadrature Demodulator is stored in memory capacitor C552 during burst time. The memory level passes through voltage follower U510D to Q470, the Lock Detector delay circuit.

Before lock acquisition, Q470 is on, Q472 is not charged, Q462 is on, and Q463 is off. The junction of R467 and R468 is referenced to −15 V and the band switch (Q469) is on. During lock acquisition, the output of U510D goes far enough positive to turn Q470 off, allowing C472 to charge towards +15 V. After about 200 ms, Q462 turns off and the multivibrator switches states. When Q463 turns on, the band switch is turned off, and Q460 turns off, removing the 0 volt unlock level from Interface line 51.

Burst Detector and AGC

The output of the Amplitude Detector is stored in memory capacitor C563 and applied through voltage follower U510A to two circuits. U510C is connected as a Schmitt circuit, with a positive output when burst is present. U510B is a rate-limited amplifier with an output that is less negative the larger the input burst. U510B's output is applied to the Chroma Amplifier gain cell on Diagram 4a. U510A's output is applied to the Control Voltage Switching circuit.

Q545 inhibits the clamp timing pulse if Interface line 52 goes to 0 volt. This condition is present when the SPG2 is in the INTERNAL mode, or when the gen-lock signal is lost.

Control Voltage Switching

With the circuit locked, the positive output from U510C turns off Q474, Q464, and Q475. The 1410 Subcarrier Oscillator control is directly from U489A in this condition.

When unlocked, U510A's output is negative, turning Q474, Q464, and Q475 on. The 1410 Subcarrier Oscillator is then controlled by the setting of R456 as a voltage divider between −15 volts and ground.

DIAGRAM ⑤

Diagram 5a Pulse Output Amplifiers

The circuits on Diagram 5a accepts signals from Sync Timing board A20 (see Diagrams 1a and 1b), and drive loads connected to the 1410 rear-panel output connectors. Each integrated circuit contains two completely independent amplifiers with rise and fall times matched and controlled by external timing capacitors (designated "Rate" on the diagram).

The output level excursion for each amplifier is from 0 to −8 volts open circuit, and 0 to −4 volts when terminated in 75 Ω at the 1410 rear panel connectors.

In most cases, the signal received from the Sync Timing board is processed through its amplifier and applied to the 1410 Rear Interconnect board. Two signals, however, get some prior processing before being applied to the amplifier.

The BURST FLAG output is developed from the Burst Flag Start pulse from the Sync Timing board. U810A delays the pulse for a period of time controlled by R800. U820B sets the duration of the pulse (adjustable by R821). When the two controls are properly adjusted, the BURST FLAG pulse is the width of burst and centered on burst time. If the SPG1 or SPG2 is in an external lock mode and set for chroma disable, the level at Interface line 31 inhibits the BURST FLAG output (via U790C) upon loss of lock.

The FIELD REF output is a one-line pulse that can be generated on Field 1, line 11 or Field 3, line 10. If P836 is set for Field 1, line 11, the signal on Interface line 37 is applied via U835A directly to the pulse amplifier, U829B. If P836 is set for Field 3, line 10, however, U825, a dual D-type flipflop, divides the V/2 clock by two, generating a V/4 pulse. The V/4 pulse clocks U826, the next toggle flipflop. U826's preset input prevents U826 from toggling until U825A's Q output is high. Conditions are correct at Field 3.

At Field 3, line 9, U826 is cleared to toggle, and a low level is applied to U825A's D input. The next horizontal sync pulse clocks U825A and the Field 3, line 10 FIELD REF pulse is passed to the output amplifier, U829B.

Diagram 5b Subcarrier Output

The circuit on Diagram 5b receives subcarrier from the Subcarrier Oscillator in the 1410, passes it through the phase shifter (goniometer), and applies it to the 1410 Interface board and the 1410 Rear Interconnect board.

Subcarrier from the 1410 Subcarrier Input board A13 passes through the front-panel SUBCARRIER PHASE control to an amplifier formed by Q755, Q767, and Q768. The output load for this amplifier is the tank circuit at the collector of Q768. The tank circuit is tuned for subcarrier frequency, with C779 providing amplitude control.

The output of the tank circuit is applied to the subcarrier output amplifier consisting of Q776, Q775, and Q784. This unity-gain amplifier provides the necessary low-impedance drive for signal distribution.

DIAGRAM ⑥

A25 VIRS/BLACK BURST

PROM Timing Generator

U921 is a Programmable Read Only Memory (PROM) that derives the VIRS timing signals. The PROM is addressed by drive signals from the SPG module causing its outputs to produce the timing signals shown in Fig. 5-1.

CR933, CR941, and CR943, and CR952 are negative-logic current steering diodes driven by the outputs of U921. If pin 7 is high, CR941 will turn on, steering emitter current away from Q841, which turns off current drive through the transistor. When the PROM's output goes low, current drive resumes and causes a current corresponding to 70 IRE to appear at the Luminance Filter output. The 50 IRE, 7.5 IRE, and chrominance levels are similarly generated.

VIRS Drive

U859 is a synchronous binary counter connected to produce a VIRS pulse for use at U921. U855A controls the VIRS pulse output depending on the position of the VIRS pushbutton switch. The counter is clocked by composite sync from U853D. The load input is driven by vertical drive from U851C. Line 18 or Line 19 may be selected by grounding pin 15 or pin 1 with the jumper connector.

Sync and Setup Drive

Gate U815D passes composite blanking and vertical drive when the Black Burst/Full Field Ref pushbutton is in the Full Field Ref position thus enabling U921 to generate the full field VIR signal. U851B passes the VIRS pulse which enables U921 during Line 18 or Line 19. Q955 and Q962 provide current during composite sync time and setup time.

Modulator

U918 is a double-balanced modulator that produces at its output (pins 6 and 9) sidebands proportional to the product of the input signal voltages (pins 1 and 4) and the carrier signal (pins 7 and 8). The modulated chrominance output signal is coupled by T928 to the Chrominance Bandpass Filter. This filter provides a bandpass response whose center frequency is tunable by L938 and L948 to 3.58 MHz. The signal then passes through the Chrominance Gain control to the Output Amplifier.

Burst Drive

Q903 is turned on during burst time to provide burst drive current to the Modulator. The burst gate signal is filtered and shaped in the collector circuit.

Subcarrier AGC and Limiter

This circuit ensures that the Modulator is always driven with a constant subcarrier signal amplitude. The circuit also maintains correct input waveform symmetry to provide balanced drive to the Modulator.

Q880 provides isolation from the subcarrier source. C865 and L863 provide adjustment of TSG4 subcarrier phase to 1410 subcarrier phase. The subcarrier signal is limited to a 50% duty cycle at the collector of Q875. Paraphase amplifier Q876 and Q878 provides AGC and drives push-pull output stages Q897 and Q898. Thus, the subcarrier signal at T908's secondary is of constant amplitude and shape.

Output Amplifier

This circuit is a non-inverting operational amplifier that combines chrominance and luminance at its summing input, provides dc level and gain adjustments, and presents a low impedance at its output. There is sufficient output to drive two 75 Ω external loads.

MAINTENANCE

INTRODUCTION

This section is divided into three parts: Maintenance, Troubleshooting, and Repair.

Maintenance includes inspection, cleaning, and recalibration. Troubleshooting contains information for isolating a trouble to a component. Repair includes procedures for removing and replacing components.

MAINTENANCE

A regular schedule of maintenance can improve instrument reliability. How often the maintenance is performed should be determined by the severity of the operating environment. Turn off the instrument power and remove the power cord before cleaning the module.

Cleaning

Dust accumulating on the circuit board acts as an insulating blanket, preventing efficient heat dissipation, and possibly causing overheating and component breakdown. A layer of dust can also provide an electrical conduction path, especially under high humidity conditions.

CAUTION

Avoid the use of chemical cleaning agents that might damage the plastics used in this instrument. Avoid chemicals that contain benzene, toluene, xylene, or similar solvents.

The best way to remove heavy accumulations of dust is to blow it off with dry, low-velocity air jet. Remaining dust can be removed with a small brush followed by a soft cloth dampened in a mild detergent and water solution. A cotton-tipped applicator is useful in tight places.

WARNING

THE FOLLOWING SHOULD BE PERFORMED BY QUALIFIED SERVICE PERSONNEL ONLY.

Visual Inspection

Visually inspect the circuit board or boards during the maintenance routine for such defects as broken connectors, loose or disconnected pin connectors, improperly seated transistors and integrated circuits, and damaged components. Make sure that the boards are properly seated on the 1410 Mainframe Interface jacks. Boards with shields should be parallel to each other and held firmly by the plastic clips provided for this purpose.

The corrective procedure for most visible defects is obvious; however, care must be taken to determine and correct the cause of heat-damaged components. Heat damage is sometimes an indication of trouble elsewhere in the instrument.

Multi-Pin Connectors

Board output signals are fed to the rear-panel connectors through coaxial cable and multi-pin connectors. The connector holder has identification numbers that identify terminal connectors No. 2 and up. A triangular key symbol is also located on the circuit board to identify pin No. 1 (see Fig. 6-1) so that the connector can be properly oriented.

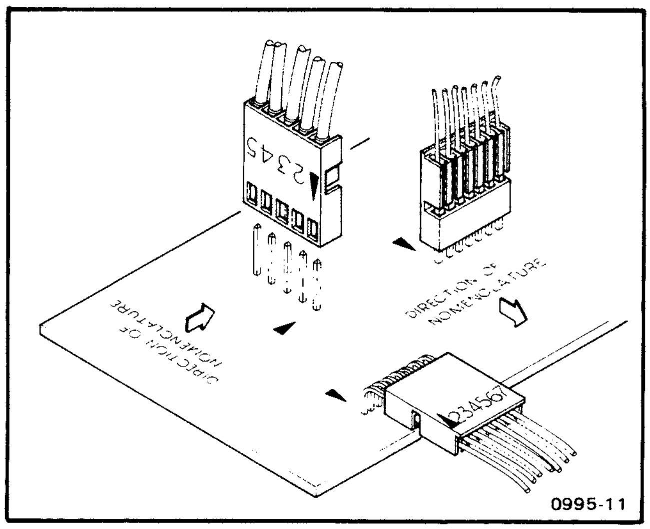


Fig. 6-1. Multi-pin circuit board connector.

Transistor and Integrated Circuit Checks

Periodic transistor and integrated circuit checks are not recommended. The best performance check for these devices is actual operation of the instrument. Performance of the circuit is thoroughly checked during the performance check or calibration procedure. Any sub-standard transistors or integrated circuits will usually be detected at that time.

Recalibration

The length of time between recalibration depends on the amount of use the circuitry receives, the nature of the environment, and the change in performance when some components are replaced.

In general, a partial recalibration is necessary if the components replaced affect the board calibration. Complete recalibration is recommended if the board or boards are not operating to their full capability. To ensure correct and accurate operation, performance should be checked at regular intervals; for example, after 1000 hours of operation if used continuously, or every six months if used infrequently.

A Performance Check/Calibration Procedure is given in Section 4.

TROUBLESHOOTING

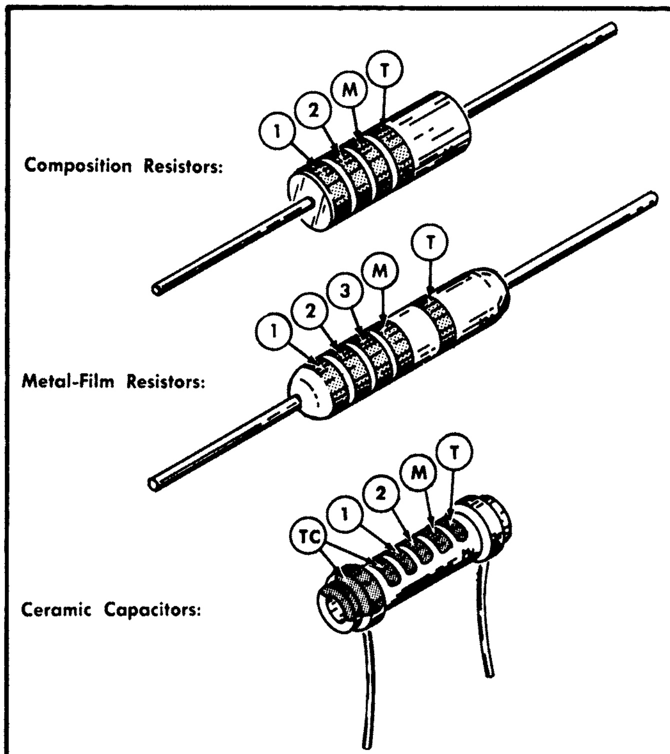
Information contained here may be used as a guide in locating circuit failures. The schematic diagrams, circuit description, and calibration sections should be referred to for fast, efficient location and repair of defects.

Diagrams

Circuit diagrams are shown on the foldout pages in Section 9. The circuit and electrical value of each component is shown on the diagrams. Important waveforms are also shown.

Circuit Boards

The circuit boards are outlined in blue on the schematic diagrams. Circuit board illustrations are provided on the back of the foldout pages that precede the revelant diagrams. The assembly number assigned to each circuit board is an abbreviated method for identifying the board.



(1) (2) and (3) —1st, 2nd and 3rd significant figures;
(M) —multiplier; (T) —tolerance;
(TC) —temperature coefficient.

Resistor and Capacitor Color Code

Color	Significant Figures	Multiplier		Tolerance	
		Resistors	Capacitors	Resistors	Capacitors
Silver	---	10^{-2}	---	±10%	---
Gold	---	10^{-1}	---	±5%	---
Black	0	1	1	---	±20% or 2 pF*
Brown	1	10	10	±1%	±1% or 0.1 pF*
Red	2	10^{2}	10^{2}	±2%	±2%
Orange	3	10^{3}	10^{3}	±3%	±3%
Yellow	4	10^{4}	10^{4}	±4%	+100% −0%
Green	5	10^{5}	10^{5}	±0.5%	±5% or 0.5 pF*
Blue	6	10^{6}	10^{6}	---	---
Violet	7	---	---	---	---
Gray	8	---	10^{-2}	---	+80% −20% or 0.25 pF*
White	9	---	10^{-1}	---	±10% or 1 pF*
(none)	---	---	---	±20%	±10% or 1 pF*

*For capacitance of 10 pF or less.

NOTE: (T) and/or (TC) color code for capacitors depends upon manufacturer and capacitor type. May not be present in some cases.

Fig. 6-2. Color Code for resistors and ceramic capacitors.

When troubleshooting the circuit boards in the instrument, the use of an extender board facilitates access to the board connections and components. Removing the suspected circuit board to the extender board will save time in looking for faults. Carefully align the board pin connectors to ensure good contact.

Circuit numbers are assigned on a grid system to facilitate component location. Low numbers start at the lower front corner of the board increasing to the rear and top.

Troubleshooting Charts

Troubleshooting charts are shown in "decision-tree" format in Section 8, Servicing Illustrations, of this manual. While the charts for an instrument as complex as the SPG1 or SPG2 cannot be inclusive, they will provide valuable assistance in troubleshooting procedures.

Wire Color Code

Insulated wires are color-coded to facilitate circuit tracing.

Resistor Color Code

Color stripes on resistors signify electrical values, tolerances, etc., according to the EIA standard color code (see Fig. 6-2). Resistors not color-coded usually have the value imprinted on the body.

Capacitor Markings

The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. White ceramic capacitors are color coded in picofarads using a modified EIA code (see Fig. 6-2). The "tear drop" capacitors are color-coded in microfarads using a modified EIA code, with the dot indicating both temperature and positive (+) side. See Fig. 6-3.

Rated Voltage VDC 25°C	Color	CODE FOR CAPACITANCE IN PICOFARADS		
		1st Figure	2nd Figure	Multiplier—pF
4	Black	0	0	None
6	Brown	1	1	X 10
10	Red	2	2	X 10^2
15	Orange	3	3	X 10^3
20	Yellow	4	4	X 10^4
25	Green	5	5	X 10^5
35	Blue	6	6	X 10^6
50	Violet	7	7	X 10^7
	Gray	8	8	
3	White	9	9	

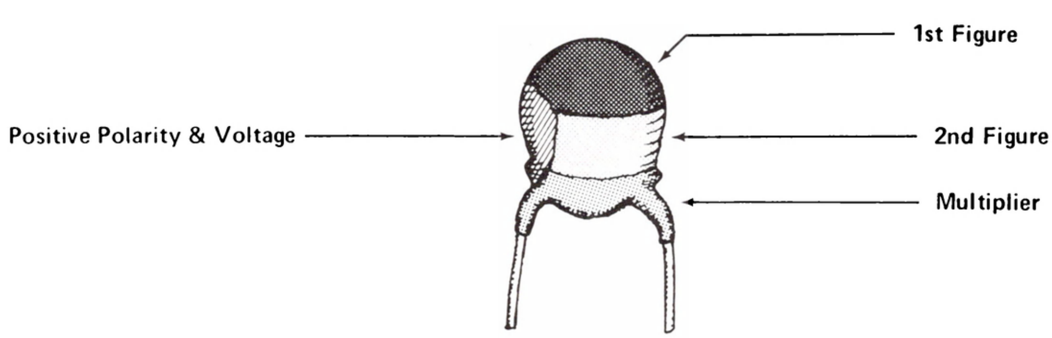


Fig. 6-3. Color coding for dipped tantalum "tear drop" capacitors.

Transistor and Integrated Circuit Lead Configurations. Fig. 6-4 illustrates the lead configurations for the socket-mounted transistors and integrated circuits (IC) used on the circuit board.

IC Diagrams

Positive logic functions of the IC's are shown in Section 8 of this manual.

Troubleshooting Equipment

The following test equipment is useful for troubleshooting the generator circuit boards.

1. Test Oscilloscope. For viewing waveforms at various test points in the circuit. Frequency response: dc to at least 10 MHz. It should be equipped with a 10X probe.

2. DVM and Ohmmeter. For measuring dc voltages and resistances accurately. The ohmmeter is also required for checking continuity.

3. Semiconductor Tester. Some means of testing the transistors and diodes is helpful. A transistor-curve tracer such as the Tektronix Type 577 will give the most complete information.

Troubleshooting Procedure

This procedure starts with simple, but sometimes taken-for-granted problem areas and proceeds to detailed troubleshooting.

1. Check Control Settings. Incorrect control settings or wrong internal jumper positions can indicate a trouble that does not exist. If there is any question about the correct function or operation of any control or jumper, refer to the Operating Instructions or Installation sections.

2. Check Associated Boards. Before troubleshooting a board, check that the Sync Timing board is operating properly and supplying the correct signals to the Mainframe Interconnect board. Make sure that other boards on the Interconnect board are not defective. Check that the test oscilloscope probe, if used, is not defective.

3. Isolate Trouble to a Circuit. Symptoms will often identify the circuit in which the trouble is located. Incorrect operation of all circuits often means trouble in the power supply section of the Mainframe. Consider this possibility if voltages are incorrect. Make sure that all board pin connectors are making good contact before proceeding with trouble isolation.

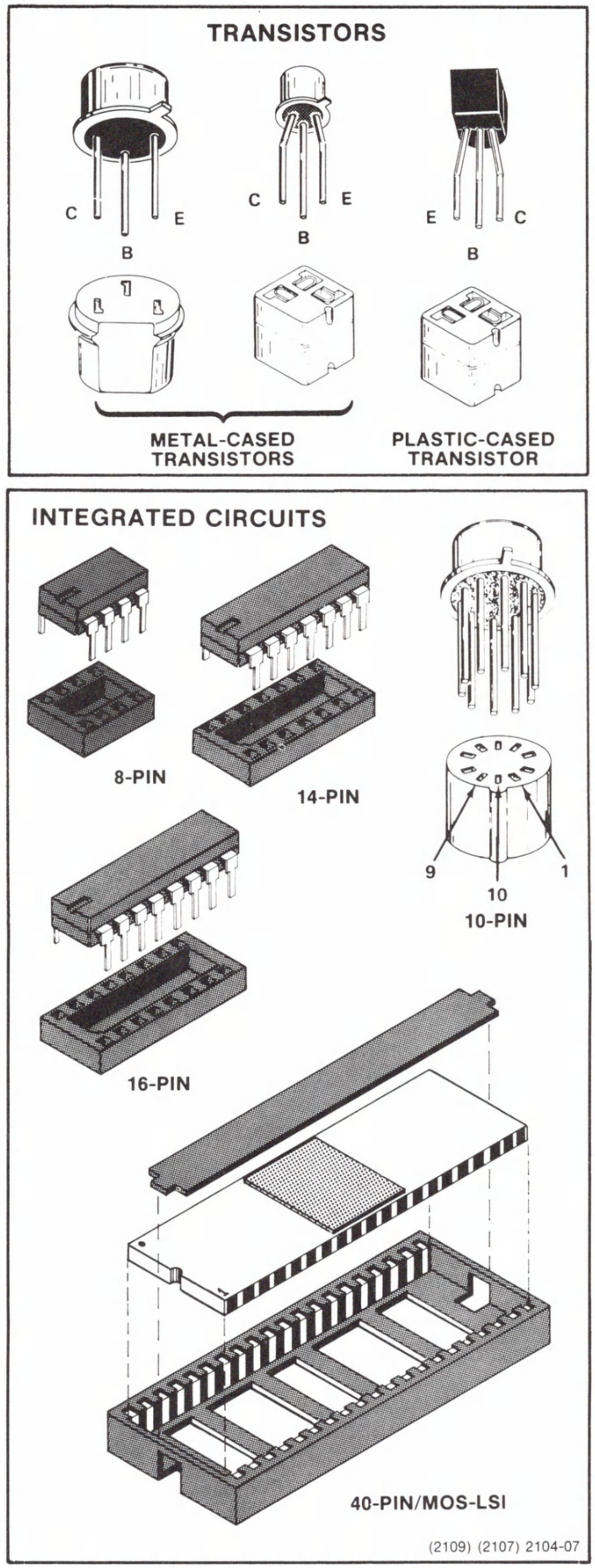


Fig. 6-4. Basing diagram for semiconductors.

@

4. Visual Check. Visually check the portion of the board in which the trouble is suspected. Some troubles can be located by checking for unsoldered connections, broken wires, loosely seated transistors, loose-fitting connectors, damaged components, or damaged circuit boards.

5. Check Voltages and Waveforms. Often the defective component or stage can be located by checking for the correct voltage or waveform in the circuit. Typical waveforms are given near the diagram. To obtain operating conditions similiar to those used to take these waveforms, refer to the instructions at the start of the diagram section.

CAUTION

Due to component density on the circuit board, special care should be exercised when using meter leads and tips. Accidental shorts can cause abnormal voltages or transients that may destroy many components.

WARNING

"Ground lugs" are not always at ground potential. Check the diagram before using such connections as ground for meter prods or oscilloscope probes. Some transistor cases may be elevated from ground potential.

6. Check Individual Components. After the trouble has been isolated to one circuit or stage, the next step is to isolate the trouble to one component or part. Components that are soldered in place are best checked by disconnecting one end to isolate the measurement from the effects of surrounding circuitry. The following methods are provided for checking individual electrical components in the module.

a. Transistors. The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can be checked by substituting a new component or one which has been checked previously. However, be sure that the circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester (such as the Tektronix Type 577) to check the transistor.

b. Integrated Circuits. Integrated circuits should not be replaced unless they are actually defective. The best method for checking these devices is by direct substitution with a new component or one which is known to be good. Be sure that circuit conditions are not such that a replacement component might be damaged.

c. Diodes. A diode can be check for an open or shorted condition by measuring the resistance between terminals. Use an ohmmeter, set to the 1k scale to keep from damaging the diode, for measuring the diode resistance. The resistance should be very high in one direction and very low when the ohmmeter leads are reversed.

d. Resistors. Resistors can be checked with an ohmmeter: Check the Replaceable Electrical Parts list for the tolerance of the resistors used in the instrument. Resistors normally do not need to be replaced unless the measured value varies widely from the specified value.

e. Inductors and Switch Contacts. Check for an open circuit (that should normally be closed) by checking continuity with an ohmmeter.

f. Capacitors. A leaky or shorted capacitor can best be detected by checking the resistance with an ohmmeter on the highest scale. Do not exceed the voltage rating of the capacitor. An open capacitor can best be detected with a capacitance meter or by checking whether the capacitor passes ac signals.

REPAIR

Corrective maintenance consists of component replacement and circuit board repair. Special techniques required to replace components in this instrument are given here.

Soldering Techniques

WARNING

Disconnect the instrument power cord before soldering.

Reliability and optimum performance of circuit boards can be maintained only if proper soldering techniques are used when repairing or replacing parts. Soldering techniques that apply to maintenance of precision electronic equipment should be used when working on the bboards. Use only 60/40 rosin-core, electronic grade solder. The choice of soldering iron is determined by the repair to be made. When soldering on circuit boards, use a 15- to 25-watt pencil-type soldering iron with a 1/8-inch wide, wedge-shaped tip. Keep the tip properly tinned for best heat transfer to the solder joint. A higher wattage soldering iron may separate the etched wiring from the bbase material. Avoid excessive heat; apply only enough heat to remove the component or to make a good solder joint. Also, apply only enough solder to make a firm solder joint; do not apply too much solder. Use a desoldering tool or other device when it is necessary to remove excess solder.

The pencil-type soldering iron used on the circuit boards can be used for soldering to switch terminals, poteniometers, or metal terminals mounted in plastic holders. For ground lugs that are connected to the chassis, or other metal terminals that are connected to a large heat-radiating surface, use a higher wattage rating soldering iron with a larger tip.

After soldering is completed, clean the area around the solder connection with a flux-remover solvent. Be careful not to remove any information printed in the area.

Location Guide for Replacing Parts

The exploded view drawings associated with the Replaceable Mechanical Parts list (located at the rear of the manual) are helpful in the removal or disassembly of individual components or subassemblies. Circuit board illustrations are provided on the backs of fold-out pages in the Diagrams section of this manual.

Pushbutton Switch Replacement

Before removing a pushbutton switch, disengage the pushbutton actuating arm so that it does not project beyond the rear of the switch. Next carefully pry back the plastic retainer clip at the rear of the switch with the tip of a small screwdriver (see Fig. 6-5). Remove by lifting the switch body up and back from the front retainer clip.

Reverse the removal procedure to install the replacement switch.

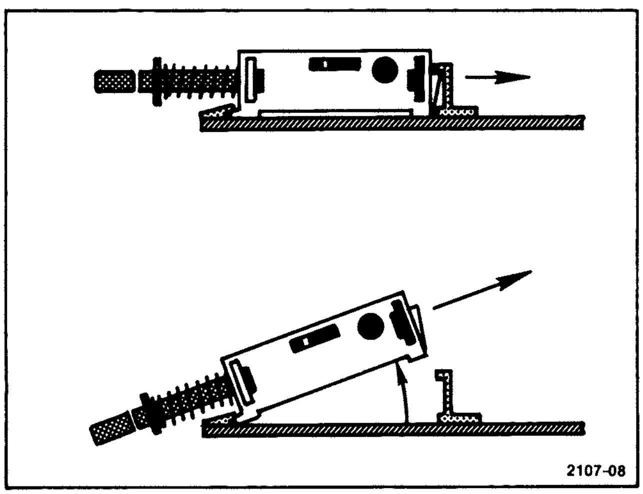


Fig. 6-5. Pushbutton switch replacement.

Circuit Board Replacement

If a circuit board is damaged beyond repair, the entire assembly, including all components, can be replaced. Tektronix part numbers are given in the Replaceable Electrical Parts list.

Circuit Board Removal.

1. Disconnect the multi-pin connectors from the board. Note the order of these connectors so they can be correctly replaced. Disconnect any other connectors that are used for interconnection with other circuits.

2. Disengage the front-panel knobs by pulling them straight out from the front panel until the board controls are free. Remove the plastic retaining clips from the top of the boards.

3. Grasp the board at both ends and pull straight up from the Interface board.

4. To replace the board, reverse the order of removal. Use the mating plastic guides to align the board pin connectors. Match the triangle key symbol on the multi-pin connectors to the same symbol on the board.

5. An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Tektronx, Inc. Order Tektronix Part No. 003-0619-00. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the IC. Try to avoid having one end of the IC disengage from the socket before the other end.

Interconnecting pins. To replace a pin that is mounted on a circuit board, first disconnect any pin connectors. Then, unsolder the damaged pin and pull it out of the board with a pair of pliers. Be careful not to damage the wiring on the board with too much heat. Ream out the hole in the circuit board with a 0.031-inch drill. Remove the ferrule from the new interconnecting pin and press the new pin into the hole in the circuit board. Position the pin in the same manner as the old pin. If the old pin was bent at an angle to mate with a connector, bend the new pin to match the associated pins.

NOTE

A pin replacement kit including necessary tools, instructions, and replacement pins is available from Tektronix, Inc. Order Tektronix Part No. 040-0542-00.

Transistors and ICs

Transistors and ICs should not be replaced unless they are actually defective. If removed from their sockets during routine maintenance, return them to their original sockets. Unnecessary replacement of transposing of semiconductors may affect the calibration of the board.

CAUTION

Disconnect the instrument power before removing or replacing semiconductors.

Any replacement component should be of the original type of a direct replacement. Cut and shape the leads to conform with the component being replaced. After a component is replaced, check the operation and calibration of associated circuits.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00213	NYTRONICS COMPONENTS GROUP INC SUBSIDIARY OF NYTRONICS INC	ORANGE ST	DARLINGTON SC 29532
00853	SANGAMO WESTON INC SANGAMO CAPACITOR DIV	SANGAMO RD P O BOX 128	PICKENS SC 29671
01121	ALLEN-BRADLEY CO	1201 SOUTH 2ND ST	MILWAUKEE WI 53204
01295	TEXAS INSTRUMENTS INC SEMICONDUCTOR GROUP	13500 N CENTRAL EXPRESSWAY P O BOX 225012 M/S 49	DALLAS TX 75265
01686	RCL ELECTRONICS INC	195 MCGREGOR ST	MANCHESTER NH 03102
02111	SPECTROL ELECTRONICS CORP SUB OF CARRIER CORP	17070 E GALE AVE P O BOX 1220	CITY OF INDUSTRY CA 91749
02735	RCA CORP SOLID STATE DIVISION	ROUTE 202	SOMERVILLE NJ 08876
03508	GENERAL ELECTRIC CO SEMI-CONDUCTOR PRODUCTS DEPT	W GENESEE ST	AUBURN NY 13021
04099	CAPCO INC	FORESIGHT INDUSTRIAL PARK P O BOX 2164	GRAND JUNCTION CO 81501
04222	AVX CERAMICS DIV OF AVX CORP	19TH AVE SOUTH P O BOX 867	MYRTLE BEACH SC 29577
04713	MOTOROLA INC SEMICONDUCTOR GROUP	5005 E MCDOWELL RD	PHOENIX AZ 85008
05397	UNION CARBIDE CORP MATERIALS SYSTEMS DIV	11901 MADISON AVE	CLEVELAND OH 44101
07263	FAIRCHILD CAMERA AND INSTRUMENT CORP SEMICONDUCTOR DIV	464 ELLIS ST	MOUNTAIN VIEW CA 94042
07716	TRW INC TRW ELECTRONICS COMPONENTS TRW IRC FIXED RESISTORS/BURLINGTON	2850 MT PLEASANT AVE	BURLINGTON IA 52601
14193	CAL-R INC	1601 OLYMPIC BLVD	SANTA MONICA CA 90404
14433	ITT SEMICONDUCTORS DIV		WEST PALM BEACH FL
18324	SIGNETICS CORP	811 E ARQUES	SUNNYVALE CA 94086
19396	ILLINOIS TOOL WORKS INC PAKTRON DIVISION	900 FOLLIN LANE S E	VIENNA VA 22180
19701	MEPCO/ELECTRA INC A NORTH AMERICAN PHILIPS CO	P O BOX 760	MINERAL WELLS TX 76067
24546	CORNING GLASS WORKS	550 HIGH ST	BRADFORD PA 16701
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051
31471	AMERICAN MICRO SYSTEMS INC	3800 HOMESTEAD RD	SANTA CLARA CA 95051
31918	ITT SCHADOW INC	8081 WALLACE RD	EDEN PRAIRIE MN 55343
32159	WEST-CAP ARIZONA	2201 E ELVIRA ROAD	TUCSON AZ 85706
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507
51642	CENTRE ENGINEERING INC	2820 E COLLEGE AVE	STATE COLLEGE PA 16801
52763	STETTNER ELECTRONICS INC	6135 AIRWAYS BLVD PO BOX 21947	CHATTANOOGA TN 37421
52769	SPRAGUE-GOODMAN ELECTRONICS INC	134 FULTON AVE	GARDEN CITY PARK NY 11040
54473	MATSUSHITA ELECTRIC CORP OF AMERICA	ONE PANASONIC WAY	SECAUCUS NJ 07094
54583	TDK ELECTRONICS CORP	755 EASTGATE BLVD	GARDEN CITY NY 11530
55680	NICHICON /AMERICA/ CORP	927 E STATE PKY	SCHAUMBURG IL 60195
56289	SPRAGUE ELECTRIC CO	87 MARSHALL ST	NORTH ADAMS MA 01247
57668	ROHM CORP	16931 MILLIKEN AVE	IRVINE CA 92713
59660	TUSONIX INC	2155 N FORBES BLVD	TUCSON, ARIZONA 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO TX 79915
71590	GLOBE-UNION INC CENTRALAB ELECTRONICS DIV	HWY 20 W P O BOX 858	FORT DODGE IA 50501
75042	TRW INC TRW ELECTRONIC COMPONENTS IRC FIXED RESISTORS PHILADELPHIA DIV	401 N BROAD ST	PHILADELPHIA PA 19108
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
80031	MEPCO/ELECTRA INC	22 COLUMBIA RD	MORRISTOWN NJ 07960
81073	GRAYHILL INC	561 HILLGROVE AVE P O BOX 373	LA GRANGE IL 60525
TK0040	TRIO-TECH RELIABILITY	975 BENICIA AVE	SUNNYVALE CA 94086
TK1345	ZMAN AND ASSOCIATES	7633 S 180TH	KENT WA 98032
TK1727	PHILIPS NEDERLAND BV AFD ELONCO	POSTBUS 90050	5600 PB EINDHOVEN THE NETHERLANDS

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A20	670-4446-00	B010100	B010136	CIRCUIT BD ASSY:SYNC TIMING (SPG1 ONLY)	80009	670-4446-00
A20	670-4446-03	B010137	B019999	CIRCUIT BD ASSY:SYNC TIMING (SPG1 ONLY)	80009	670-4446-03
A20	670-4446-04	B020000	B020219	CIRCUIT BD ASSY:SYNC TIMING (SPG1 ONLY)	80009	670-4446-04
A20	670-4446-08	B020220	B020359	CIRCUIT BD ASSY:SYNC TIMING (SPG1 ONLY)	80009	670-4446-08
A20	670-4446-13	B020360		CIRCUIT BD ASSY:SYNC TIMING (SPG1 ONLY)	80009	670-4446-13
A20	670-4446-00	B010100	B010330	CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-00
A20	670-4446-03	B010331	B019999	CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-03
A20	670-4446-04	B020000	B021321	CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-04
A20	670-4446-08	B021322	B022893	CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-08
A20	670-4446-13	B022894	B023248	CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-13
A20	670-4446-16	B023249		CIRCUIT BD ASSY:SYNC TIMING (SPG2 ONLY)	80009	670-4446-16
A21	670-4447-00	B010100	B010136	CIRCUIT BD ASSY:SYNC LOCK (SPG1 ONLY)	80009	670-4447-00
A21	670-4447-01	B010137	B012485	CIRCUIT BD ASSY:SYNC LOCK (SPG1 ONLY)	80009	670-4447-01
A21	670-4447-02	B012486		CIRCUIT BD ASSY:SYNC LOCK (SPG1,SPG2)	80009	670-4447-02
A21	670-4447-00	B010100	B010559	CIRCUIT BD ASSY:SYNC LOCK (SPG2 ONLY)	80009	670-4447-00
A21	670-4447-01	B010560	B012485	CIRCUIT BD ASSY:SYNC LOCK (SPG2 ONLY)	80009	670-4447-01
A21	670-4447-02	B012486	B029999	CIRCUIT BD ASSY:SYNC LOCK (SPG1,SPG2)	80009	670-4447-02
A21	670-9231-00	B030000		CIRCUIT BD ASSY:SYNC LOCK	80009	670-9231-00
A22	670-4448-00	B010100	B010139	CIRCUIT BD ASSY:GENERATOR LOGIC (SPG1 ONLY)	80009	670-4448-00
A22	670-4448-03	B010140	B020291	CIRCUIT BD ASSY:GENERATOR LOGIC (SPG1 ONLY)	80009	670-4448-03
A22	670-4448-05	B020292		CIRCUIT BD ASSY:GENERATOR LOGIC (SPG1 ONLY)	80009	670-4448-05
A22	670-4448-00	B010100	B010579	CIRCUIT BD ASSY:GENERATOR LOGIC (SPG2 ONLY)	80009	670-4448-00
A22	670-4448-03	B010580	B021841	CIRCUIT BD ASSY:GENERATOR LOGIC (SPG2 ONLY)	80009	670-4448-03
A22	670-4448-05	B021842		CIRCUIT BD ASSY:GENERATOR LOGIC (SPG2 ONLY)	80009	670-4448-05
A23	670-4449-00	B010100	B021075	CIRCUIT BD ASSY:SUBCARRIER LOCK (SPG2 ONLY)	80009	670-4449-00
A23	670-4449-03	B021076	B022219	CIRCUIT BD ASSY:SUBCARRIER LOCK (SPG2 ONLY)	80009	670-4449-03
A23	670-4449-05	B022220	B023196	CIRCUIT BD ASSY:SUBCARRIER LOCK (SPG2 ONLY)	80009	670-4449-05
A23	670-4449-07	B023197		CIRCUIT BD ASSY:SUBCARRIER LOCK (SPG2 ONLY)	80009	670-4449-07
A24	670-4450-00			CIRCUIT BD ASSY:PULSE OUTPUT AMPLIFIER	80009	670-4450-00
A25	670-4451-00	B010100	B010126	CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG1 ONLY)	80009	670-4451-00
A25	670-4451-01	B010127	B020210	CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG1 ONLY)	80009	670-4451-01
A25	670-4451-02	B020211		CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG1 ONLY)	80009	670-4451-02
A25	670-4451-00	B010100	B010437	CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG2 ONLY)	80009	670-4451-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
A25	670-4451-01	B010438	B021236	CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG2 ONLY)	80009	670-4451-01
A25	670-4451-02	B021237	B023190	CIRCUIT BD ASSY:VIRS/BLACK BURST (SPG2 ONLY)	80009	670-4451-02
A25	670-4451-04	B023191		CIRCUIT BD ASSY:VIRS/BLOCK BURST (SPG2 ONLY)	80009	670-4451-04
A27	670-4453-00			CIRCUIT BD ASSY:LED	80009	670-4453-00
A100	670-4459-00			CIRCUIT BD ASSY:SHIELD	80009	670-4459-00
C100	283-0023-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C100	281-0775-00	B020000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C103	281-0576-00			CAP,FXD,CER DI:11PF,5%,500V (SPG2 ONLY)	52763	2RDPLZ007 MPOJC
C103	281-0576-00	B010135		CAP,FXD,CER DI:11PF,5%,500V (SPG1 ONLY)	52763	2RDPLZ007 MPOJC
C110	281-0812-00	B023249		CAP,FXD,CER DI:1000PF,10%,100V (SPG2 ONLY)	04222	MA101C102KAA
C112	283-0649-00			CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C114	283-0672-00			CAP,FXD,MICA DI:200PF,1%,500V	00853	D155F2010F0
C122	283-0023-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C123	----- -----	B010101		TEST SELECTABLE (SPG1 ONLY) TEST SELECTABLE (SPG2 ONLY)		
C124	----- -----	B010101	B020219	TEST SELECTABLE (SPG1 ONLY)		
C124	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V (SPG1 ONLY) TEST SELECTABLE (SPG2 ONLY)	04222	MA101A470KAA
C124	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V (SPG 2 ONLY)	04222	MA101A470KAA
C125	290-0782-00	B010100	B019999	CAP,FXD,ELCTLT:4.7UF,+75-10%,35VDC	55680	ULB1V4R7TAAANA
C125	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V (SPG1 ONLY)	04222	MA101A470KAA
C125	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V (SPG2 ONLY)	04222	MA101A470KAA
C126	283-0649-00	B010100	B019999	CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C126	283-0647-00	B020000		CAP,FXD,MICA DI:70PF,1%,100V	00853	D155E700F0
C127	283-0644-00			CAP,FXD,MICA DI:150PF,1%,500V	00853	D155F151F0
C128	283-0024-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C129	283-0024-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C130	290-0782-00			CAP,FXD,ELCTLT:4.7UF,+75-10%,35VDC	55680	ULB1V4R7TAAANA
C135	283-0024-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C136	283-0000-00			CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C137	283-0000-00	B010100	B019999	CAP,FXD,CER DI:0.001UF,+100-0%,500V	59660	831-610-Y5U0102P
C137	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V (SPG1 ONLY)	04222	MA101A470KAA
C137	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V (SPG2 ONLY)	04222	MA101A470KAA
C138	281-0791-00			CAP,FXD,CER DI:270PF,10%,100V	04222	MA101C271KAA
C139	281-0791-00	B010100	B019999	CAP,FXD,CER DI:270PF,10%,100V	04222	MA101C271KAA
C139	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V (SPG1 ONLY)	04222	MA101A470KAA
C139	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V (SPG2 ONLY)	04222	MA101A470KAA
C140	283-0023-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C141	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V (SPG1 ONLY)	04222	MA101A470KAA
C141	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V (SPG2 ONLY)	04222	MA101A470KAA
C142	----- -----	B010101	B020219	TEST SELECTABLE		

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG1 ONLY)		
C142	281-0763-00	B020220		CAP,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
				(SPG1 ONLY)		
				TEST SELECTABLE		
				(SPG2 ONLY)		
C142	281-0763-00	B021322		CAP,FXD,CER DI:47PF,10%,100V	04222	MA101A470KAA
				(SPG2 ONLY)		
C143	----- -----	B010101		TEST SELECTABLE		
				(SPG1 ONLY)		
				TEST SELECTABLE		
				(SPG2 ONLY)		
C144	----- -----	B010101		TEST SELECTABLE		
				(SPG1 ONLY)		
				TEST SELECTABLE		
				(SPG2 ONLY)		
C145	----- -----	B010101		TEST SELECTABLE		
				(SPG1 ONLY)		
				TEST SELECTABLE		
				(SPG2 ONLY)		
C146	285-1101-00	B010100	B010136	CAP,FXD,PLASTIC:0.022UF,10%,200V	19396	223K02PT485
				(SPG1 ONLY)		
C146	285-0901-00	B010137		CAP,FXD,PLASTIC:0.047UF,5%,50V	04099	TEK-15-5
				(SPG1 ONLY)		
C146	285-1101-00	B010100	B010559	CAP,FXD,PLASTIC:0.022UF,10%,200V	19396	223K02PT485
				(SPG2 ONLY)		
C146	285-0901-00	B010560		CAP,FXD,PLASTIC:0.047UF,5%,50V	04099	TEK-15-5
				(SPG2 ONLY)		
C147	283-0649-00	B010100	B019999	CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C147	283-0638-00	B020000		CAP,FXD,MICA DI:130PF,1%,100V	00853	D155F131F0
C150	283-0024-00			CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C152	283-0633-00			CAP,FXD,MICA DI:77PF,1%,100V	00853	D155E770F0
C154	283-0615-00			CAP,FXD,MICA DI:33PF,5%,500V	00853	D155E330J0
C155	283-0645-00			CAP,FXD,MICA DI:790PF,1%,100V	00853	D153F791F0
C157	283-0692-00			CAP,FXD,MICA DI:670PF,1%,300V	00853	D153F671F0
C159	281-0204-00			CAP,VAR,PLASTIC:2-22PF,100V	80031	2807C00222MJ02
C160	283-0024-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C160	281-0775-00	B020000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C162	283-0023-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C162	281-0775-00	B020000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C163	283-0024-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,50V	04222	SR215C104MAA
C163	281-0775-00	B020000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C165	285-0916-00			CAP,FXD,PLASTIC:0.01UF,5%,100V	04099	TEK13-11
C166	283-0028-00	B010100	B020359	CAP,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5S0222M
				(SPG1 ONLY)		
C166	283-0119-00	B020360		CAP,FXD,CER DI:2200PF,5%,200V	59660	855-XXXY5E0222J
				(SPG1 ONLY)		
C166	283-0028-00	B010100	B022893	CAP,FXD,CER DI:0.0022UF,20%,50V	59660	0805585Y5S0222M
				(SPG2 ONLY)		
C166	283-0119-00	B022894		CAP,FXD,CER DI:2200PF,5%,200V	59660	855-XXXY5E0222J
				(SPG2 ONLY)		
C168	283-0023-00	B010100	B019999	CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C168	281-0775-00	B020000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C195	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C196	281-0775-00	B030000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C198	281-0775-00	B030000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C199	283-0769-00	B030000		CAP,FXD,MICA DI:278 PF,1%,500V	00853	D155F2780F0
C200	281-0852-00	B030000		CAP,FXD,CER DI:1800PF,10%,100VDC	04222	MA101C182KAA
C201	281-0775-00	B030000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C202	283-0665-00	B010100	B029999	CAP,FXD,MICA DI:190PF,1%,100V	00853	D155F191F0
C202	281-0852-00	B030000		CAP,FXD,CER DI:1800PF,10%,100VDC	04222	MA101C182KAA
C203	281-0775-00	B030000		CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C204	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C211	283-0597-00			CAP,FXD,MICA DI:470PF,10%,300V	00853	D155F471K0
C212	283-0198-00	B010100	B010136	CAP,FXD,CER DI:0.22UF,20%,50V (SPG1 ONLY)	05397	C330C224M5U1CA
C212	283-0111-00	B010137		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	05397	C330C104M5U1CA
C212	283-0198-00	B010100	B010559	CAP,FXD,CER DI:0.22UF,20%,50V (SPG2 ONLY)	05397	C330C224M5U1CA
C212	283-0111-00	B010560		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	05397	C330C104M5U1CA
C218	283-0649-00			CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C219	283-0637-00			CAP,FXD,MICA DI:20PF,2.5%,500V	00853	D155E200D0
C245	281-0786-00			CAP,FXD,CER DI:150PF,10%,100V	04222	MA101A151KAA
C249	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C252	283-0341-00			CAP,FXD,CER DI:0.047UF,10%,100V	04222	SR301C473KAA
C260	283-0622-00			CAP,FXD,MICA DI:450PF,1%,300V	00853	D155F451F0
C265	281-0786-00			CAP,FXD,CER DI:150PF,10%,100V	04222	MA101A151KAA
C275	283-0111-00			CAP,FXD,CER DI:0.1UF,20%,50V	05397	C330C104M5U1CA
C279	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C281	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
C282	290-0517-00			CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T368B685M035AZ
C283	290-0517-00			CAP,FXD,ELCTLT:6.8UF,20%,35V	05397	T368B685M035AZ
C284	283-0648-00			CAP,FXD,MICA DI:10PF,5%,500V	00853	D155C100D0
C285	283-0644-00			CAP,FXD,MICA DI:150PF,1%,500V	00853	D155F151F0
C290	290-0534-00	B030000		CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
C295	283-0065-00			CAP,FXD,CER DI:0.001UF,5%,100V	59660	0835-591Y5E0102J
C298	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C307	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C314	283-0622-00			CAP,FXD,MICA DI:450PF,1%,300V	00853	D155F451F0
C318	281-0788-00			CAP,FXD,CER DI:470PF,10%,100V	04222	MA101C471KAA
C319	281-0788-00			CAP,FXD,CER DI:470PF,10%,100V	04222	MA101C471KAA
C324	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C335	283-0635-00			CAP,FXD,MICA DI:51PF,1%,100V	00853	D151E510F0
C336	283-0666-00			CAP,FXD,MICA DI:890PF,2%,100V	00853	D151F891G0
C338	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C339	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C374	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C386	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C397	281-0788-00			CAP,FXD,CER DI:470PF,10%,100V	04222	MA101C471KAA
C400	290-0778-00			CAP,FXD,ELCTLT:1UF,+50 -10%,50V,NPLZD	54473	ECE-A50N1
C402	283-0065-00			CAP,FXD,CER DI:0.001UF,5%,100V	59660	0835-591Y5E0102J
C405	283-0238-00	B010100	B010139	CAP,FXD,CER DI:0.01UF,10%,50V (SPG1 ONLY)	04222	SR205C103KAA
C405	281-0773-00	B010140		CAP,FXD,CER DI:0.01UF,10%,100V (SPG1 ONLY)	04222	MA201C103KAA
C405	283-0238-00	B010100	B010579	CAP,FXD,CER DI:0.01UF,10%,50V (SPG2 ONLY)	04222	SR205C103KAA
C405	281-0773-00	B010580		CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C413	283-0058-00			CAP,FXD,CER DI:0.027UF,10%,100V	04222	SR301C273KAA
C414	283-0210-00	B020292		CAP,FXD,CER DI:0.0056UF,20%,100V (SPG1 ONLY)	51642	300 100-X7R-562M
C414	283-0210-00	B021842		CAP,FXD,CER DI:0.0056UF,20%,100V (SPG2 ONLY)	51642	300 100-X7R-562M
C416	281-0791-00			CAP,FXD,CER DI:270PF,10%,100V	04222	MA101C271KAA
C418	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C419	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C422	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V	04222	MA201C472KAA
C426	290-0534-00			CAP,FXD,ELCTLT:1UF,20%,35V	05397	T368A105M035AZ
C428	290-0530-00	B010140		CAP,FXD,ELCTLT:68UF,20%,6V (SPG1 ONLY)	56289	196D686X0006KA1

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C428	290-0530-00	B010580		CAP,FXD,ELCTLT:68UF,20%,6V (SPG2 ONLY)	56289	196D686X0006KA1
C435	281-0775-00			CAP,FXD,CER DI:0.1UF,20%,50V	04222	MA205E104MAA
C436	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU668104Z
C438	283-0618-00			CAP,FXD,MICA DI:130PF,2%,400V	00853	D155F131G0
C447	290-0778-00			CAP,FXD,ELCTLT:1UF,+50 -10%,50V,NPLZD	54473	ECE-A50N1
C451	283-0641-00			CAP,FXD,MICA DI:180PF,1%,100V (SPG2 ONLY)	00853	D155F181F0
C466	290-0517-00			CAP,FXD,ELCTLT:6.8UF,20%,35V (SPG2 ONLY)	05397	T368B685M035AZ
C472	290-0517-00			CAP,FXD,ELCTLT:6.8UF,20%,35V (SPG2 ONLY)	05397	T368B685M035AZ
C490	283-0177-00			CAP,FXD,CER DI:1UF,+80-20%,25V (SPG2 ONLY)	04222	SR302E105ZAATR
C493	281-0775-00	B010135		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C520	283-0080-00			CAP,FXD,CER DI:0.022UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU60E223Z
C522	283-0080-00			CAP,FXD,CER DI:0.022UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU60E223Z
C528	283-0080-00			CAP,FXD,CER DI:0.022UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU60E223Z
C540	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C549	281-0759-00			CAP,FXD,CER DI:22PF,10%,100V (SPG2 ONLY)	04222	MA101A220KAA
C552	283-0080-00			CAP,FXD,CER DI:0.022UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU60E223Z
C556	281-0759-00			CAP,FXD,CER DI:22PF,10%,100V (SPG2 ONLY)	04222	MA101A220KAA
C557	281-0759-00			CAP,FXD,CER DI:22PF,10%,100V (SPG2 ONLY)	04222	MA101A220KAA
C561	281-0791-00			CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C562	283-0111-00	B010135		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	05397	C330C104M5U1CA
C563	283-0080-00			CAP,FXD,CER DI:0.022UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU60E223Z
C564	283-0081-00			CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C567	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C573	283-0618-00			CAP,FXD,MICA DI:130PF,2%,400V (SPG2 ONLY)	00853	D155F131G0
C590	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C598	283-0680-00			CAP,FXD,MICA DI:330PF,1%,500V (SPG2 ONLY)	00853	D155F331F0
C599	283-0641-00			CAP,FXD,MICA DI:180PF,1%,100V (SPG2 ONLY)	00853	D155F181F0
C605	283-0680-00			CAP,FXD,MICA DI:330PF,1%,500V (SPG2 ONLY)	00853	D155F331F0
C606	283-0641-00			CAP,FXD,MICA DI:180PF,1%,100V (SPG2 ONLY)	00853	D155F181F0
C610	283-0680-00			CAP,FXD,MICA DI:330PF,1%,500V (SPG2 ONLY)	00853	D155F331F0
C613	283-0641-00			CAP,FXD,MICA DI:180PF,1%,100V (SPG2 ONLY)	00853	D155F181F0
C614	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C617	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C628	283-0081-00			CAP,FXD,CER DI:0.1UF,+80-20%,25V	59821	2DDU69E104Z

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
C629	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C643	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C650	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C653	283-0660-00			CAP,FXD,MICA DI:510PF,2%,500V (SPG2 ONLY)	00853	D155F511G0
C654	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C666	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C667	281-0670-00	B022220		CAP,FXD,CER DI:1.8PF,+/-0.1PF,500V (SPG2 ONLY TEST SELECTED)	52763	2RDPLZ007 1P80BC
C669	283-0256-00			CAP,FXD,CER DI:130PF,5%,100V (SPG2 ONLY)	51642	200100N1500131J
C680	283-0651-00			CAP,FXD,MICA DI:430PF,1%,500V (SPG2 ONLY)	00853	D155F431F0
C689	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C690	283-0081-00			CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C693	283-0598-00			CAP,FXD,MICA DI:253PF,5%,300V (SPG2 ONLY)	00853	D155F2530J0
C709	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C710	290-0525-00			CAP,FXD,ELCTLT:4.7UF,20%,50V (SPG2 ONLY)	05397	T368B475M050AS
C714	290-0536-00			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM (SPG2 ONLY)	05397	T368B106M025AS
C720	283-0637-00			CAP,FXD,MICA DI:20PF,2.5%,500V (SPG2 ONLY)	00853	D155E200D0
C721	283-0081-00			CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C726	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C729	281-0772-00			CAP,FXD,CER DI:4700PF,10%,100V (SPG2 ONLY)	04222	MA201C472KAA
C730	283-0004-00			CAP,FXD,CER DI:0.02UF,+80-20%,150V (SPG2 ONLY)	59660	855-558Z5V0203Z
C734	283-0177-00			CAP,FXD,CER DI:1UF,+80-20%,25V (SPG2 ONLY)	04222	SR302E105ZAATR
C735	283-0256-00			CAP,FXD,CER DI:130PF,5%,100V (SPG2 ONLY)	51642	200100N1500131J
C746	290-0745-00	B010100	B010134	CAP,FXD,ELCTLT:22UF,+50-10%,25V (SPG2 ONLY)	54473	ECE-A25V22L
C746	290-0779-00	B010135		CAP,FXD,ELCTLT:10 UF +50% -10%,50VDC (SPG2 ONLY)	56289	502D237
C751	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C758	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C775	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C776	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C777	283-0640-00			CAP,FXD,MICA DI:160PF,1%,100V	00853	D155F161F0
C778	283-0618-00			CAP,FXD,MICA DI:130PF,2%,400V	00853	D155F131G0
C779	281-0226-00			CAP,VAR,PLASTIC:5.5-65PF,100V	52769	GXD38000
C785	283-0023-00			CAP,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C790	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C797	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P70DC
C798	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C799	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C806	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P70DC

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C807	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C808	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C809	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C810	283-0649-00			CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C811	283-0644-00			CAP,FXD,MICA DI:150PF,1%,500V	00853	D155F151F0
C812	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C814	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C815	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C816	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C817	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C818	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C819	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C826	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C827	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C828	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C829	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C830	283-0003-00			CAP,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C831	283-0003-00			CAP,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C832	283-0003-00			CAP,FXD,CER DI:0.01UF,+80-20%,150V	59821	D103Z40Z5UJDCEX
C835	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C836	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C837	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C838	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C839	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C844	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C845	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C846	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C847	281-0592-00			CAP,FXD,CER DI:4.7PF,+/-0.5PF,500V	52763	2RDPLZ007 4P7DDC
C848	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C849	281-0205-00			CAP,VAR,PLASTIC:5.5-65 PF,100V	TK1727	2222-808-32659
C852	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C861	283-0648-00	B010100	B010126	CAP,FXD,MICA DI:10PF,5%,500V (SPG1 ONLY)	00853	D155C10000
C861	283-0637-00	B010127		CAP,FXD,MICA DI:20PF,2.5%,500V (SPG1 ONLY)	00853	D155E20000
C861	283-0648-00	B010100	B010437	CAP,FXD,MICA DI:10PF,5%,500V (SPG2 ONLY)	00853	D155C10000
C861	283-0637-00	B010438		CAP,FXD,MICA DI:20PF,2.5%,500V (SPG2 ONLY)	00853	D155E20000
C865	281-0226-00			CAP,VAR,PLASTIC:5.5-65PF,100V	52769	GXD38000
C867	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C867	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C867	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V (SPG2 ONLY)	59660	0831604Z5F0271J
C867	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C871	283-0000-00	B010100	B010126	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG1 ONLY)	59660	831-610-Y5U0102P
C871	283-0639-00	B010127		CAP,FXD,MICA DI:56PF,1%,100V (SPG1 ONLY)	00853	D155E560F0
C871	283-0000-00	B010100	B010437	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG2 ONLY)	59660	831-610-Y5U0102P
C871	283-0639-00	B010438		CAP,FXD,MICA DI:56PF,1%,100V (SPG2 ONLY)	00853	D155E560F0
C875	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C875	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C875	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V	59660	0831604Z5F0271J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
C875	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C877	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C877	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C877	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V (SPG2 ONLY)	59660	0831604Z5F0271J
C877	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C878	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C878	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C878	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V (SPG2 ONLY)	59660	0831604Z5F0271J
C878	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C880	281-0812-00	B010127		CAP,FXD,CER DI:1000PF,10%,100V (SPG1 ONLY)	04222	MA101C102KAA
C880	281-0812-00	B010438		CAP,FXD,CER DI:1000PF,10%,100V (SPG2 ONLY)	04222	MA101C102KAA
C883	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C884	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C884	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C884	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V (SPG2 ONLY)	59660	0831604Z5F0271J
C884	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C886	283-0047-00	B010100	B010126	CAP,FXD,CER DI:270PF,5%,500V (SPG1 ONLY)	59660	0831604Z5F0271J
C886	281-0791-00	B010127		CAP,FXD,CER DI:270PF,10%,100V (SPG1 ONLY)	04222	MA101C271KAA
C886	283-0047-00	B010100	B010437	CAP,FXD,CER DI:270PF,5%,500V (SPG2 ONLY)	59660	0831604Z5F0271J
C886	281-0791-00	B010438		CAP,FXD,CER DI:270PF,10%,100V (SPG2 ONLY)	04222	MA101C271KAA
C892	281-0773-00	B010100	B010126	CAP,FXD,CER DI:0.01UF,10%,100V (SPG1 ONLY)	04222	MA201C103KAA
C892	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C892	281-0773-00	B010100	B010437	CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C892	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C894	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C896	283-0187-00	B010100	B010126	CAP,FXD,CER DI:0.047UF,10%,400V (SPG1 ONLY)	04222	SR308C473KAA
C896	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C896	283-0187-00	B010100	B010437	CAP,FXD,CER DI:0.047UF,10%,400V (SPG2 ONLY)	04222	SR308C473KAA
C896	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C897	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C898	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C898	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C898	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C898	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C899	290-0523-00			CAP,FXD,ELCTLT:2.2UF,20%,20V	05397	T368A225M020AS
C901	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C902	283-0728-00	B010100	B010126	CAP,FXD,MICA DI:120PF,1%,500V (SPG1 ONLY)	00853	D155F121F0
C902	283-0638-00	B010127		CAP,FXD,MICA DI:130PF,1%,100V (SPG1 ONLY)	00853	D155F131F0
C902	283-0728-00	B010100	B010437	CAP,FXD,MICA DI:120PF,1%,500V (SPG2 ONLY)	00853	D155F121F0
C902	283-0638-00	B010438		CAP,FXD,MICA DI:130PF,1%,100V (SPG2 ONLY)	00853	D155F131F0
C903	283-0000-00	B010100	B010126	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG1 ONLY)	59660	831-610-Y5U0102P
C903	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C903	283-0000-00	B010100	B010437	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG2 ONLY)	59660	831-610-Y5U0102P
C903	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C904	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C904	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C904	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C904	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C911	283-0648-00			CAP,FXD,MICA DI:10PF,5%,500V	00853	D155C100D0
C916	283-0649-00			CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C919	281-0861-00			CAP,FXD,CER DI:270PF,5%,50V (BEGIN USAGE W/670-4451-04 SPG2 ONLY)	54583	MA12C0G1H271J
C920	281-0861-00			CAP,FXD,CER DI:270PF,5%,50V (BEGIN USAGE W/670-4451-04 SPG2 ONLY)	54583	MA12C0G1H271J
C921	281-0861-00			CAP,FXD,CER DI:270PF,5%,50V (BEGIN USAGE W/670-4451-04 SPG2 ONLY)	54583	MA12C0G1H271J
C922	281-0861-00			CAP,FXD,CER DI:270PF,5%,50V (BEGIN USAGE W/670-4451-04 SPG2 ONLY)	54583	MA12C0G1H271J
C923	283-0649-00	B010100	B010126	CAP,FXD,MICA DI:105PF,1%,300V (SPG1 ONLY)	00853	D155F1050F0
C923	283-0647-00	B010127		CAP,FXD,MICA DI:70PF,1%,100V (SPG1 ONLY)	00853	D155E700F0
C923	283-0649-00	B010100	B010437	CAP,FXD,MICA DI:105PF,1%,300V (SPG2 ONLY)	00853	D155F1050F0
C923	283-0647-00	B010438		CAP,FXD,MICA DI:70PF,1%,100V (SPG2 ONLY)	00853	D155E700F0
C923	290-0778-00			CAP,FXD,ELCTLT:1UF,+50 -10%,50V,NPLZD (SPG2 ONLY)	54473	ECE-A5[illegible]
C926	283-0649-00			CAP,FXD,MICA DI:105PF,1%,300V	00853	D155F1050F0
C927	281-0773-00			CAP,FXD,CER DI:0.01UF,10%,100V	04222	MA201C103KAA
C928	281-0064-00			CAP,VAR,PLASTIC:0.25-1.5PF,600V	52769	ER-530-013
C929	281-0661-00	B010100	B010126	CAP,FXD,CER DI:0.8PF,+/-0.1PF,500V (SPG1 ONLY)	52763	2RDPLZ007 0P80BC
C929	281-0661-00	B010100	B010437	CAP,FXD,CER DI:0.8PF,+/-0.1PF,500V (SPG2 ONLY)	52763	2RDPLZ007 0P80BC
C933	283-0000-00	B010100	B010126	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG1 ONLY)	59660	831-610-Y5U0102P
C933	281-0812-00	B010127	B020210	CAP,FXD,CER DI:1000PF,10%,100V (SPG1 ONLY)	04222	MA101C102KAA
C933	281-0773-00	B020211		CAP,FXD,CER DI:0.01UF,10%,100V (SPG1 ONLY)	04222	MA201C103KAA
C933	283-0000-00	B010100	B010437	CAP,FXD,CER DI:0.001UF,+100-0%,500V (SPG2 ONLY)	59660	831-610-Y5U0102P

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C933	281-0812-00	B010438	B021236	CAP,FXD,CER DI:1000PF,10%,100V (SPG2 ONLY)	04222	MA101C102KAA
C933	281-0773-00	B021237		CAP,FXD,CER DI:0.01UF,10%,100V (SPG2 ONLY)	04222	MA201C103KAA
C936	283-0730-00	B010100	B010126	CAP,FXD,MICA DI:274PF,1%,500V (SPG1 ONLY)	00853	D155F2740F0
C936	283-0725-00	B010127		CAP,FXD,MICA DI:214PF,1%,500V (SPG1 ONLY)	00853	D155F2140F0
C936	283-0730-00	B010100	B010437	CAP,FXD,MICA DI:274PF,1%,500V (SPG2 ONLY)	00853	D155F2740F0
C936	283-0725-00	B010438		CAP,FXD,MICA DI:214PF,1%,500V (SPG2 ONLY)	00853	D155F2140F0
C945	283-0639-00			CAP,FXD,MICA DI:56PF,1%,100V	00853	D155E560F0
C946	283-0687-00	B010100	B010126	CAP,FXD,MICA DI:560PF,2%,300V (SPG1 ONLY)	00853	D153F561G0
C946	283-0689-00	B010127		CAP,FXD,MICA DI:550PF,1%,300V (SPG1 ONLY)	00853	D153F551F0
C946	283-0687-00	B010100	B010439	CAP,FXD,MICA DI:560PF,2%,300V (SPG2 ONLY)	00853	D153F561G0
C946	283-0689-00	B010438		CAP,FXD,MICA DI:550PF,1%,300V (SPG2 ONLY)	00853	D153F551F0
C947	283-0643-00	B010100	B010104	CAP,FXD,MICA DI:22PF,0.5%,500V (SPG1 ONLY)	00853	D105E220D0
C947	283-0677-00	B010105		CAP,FXD,MICA DI:82PF,1%,500V (SPG1 ONLY)	00853	D155E820F0
C947	283-0643-00	B010100	B010175	CAP,FXD,MICA DI:22PF,0.5%,500V (SPG2 ONLY)	00853	D105E220D0
C947	283-0677-00	B010176		CAP,FXD,MICA DI:82PF,1%,500V (SPG2 ONLY)	00853	D155E820F0
C948	283-0638-00	B010100	B010104	CAP,FXD,MICA DI:130PF,1%,100V (SPG1 ONLY)	00853	D155F131F0
C948	283-0725-00	B010105		CAP,FXD,MICA DI:214PF,1%,500V (SPG1 ONLY)	00853	D155F2140F0
C948	283-0638-00	B010100	B010175	CAP,FXD,MICA DI:130PF,1%,100V (SPG2 ONLY)	00853	D155F131F0
C948	283-0725-00	B010176		CAP,FXD,MICA DI:214PF,1%,500V (SPG2 ONLY)	00853	D155F2140F0
C956	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C956	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C956	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C956	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C961	283-0660-00			CAP,FXD,MICA DI:510PF,2%,500V	00853	D155F511G0
C967	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C967	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C967	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C967	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C971	283-0602-00	B010100	B010126	CAP,FXD,MICA DI:53PF,5%,300V (SPG1 ONLY)	00853	D155E530J0
C971	283-0636-00	B010127		CAP,FXD,MICA DI:36PF,1.4%,100V (SPG1 ONLY)	00853	D155E360G0
C971	283-0602-00	B010100	B010437	CAP,FXD,MICA DI:53PF,5%,300V (SPG2 ONLY)	00853	D155E530J0
C971	283-0636-00	B010438		CAP,FXD,MICA DI:36PF,1.4%,100V (SPG2 ONLY)	00853	D155E360G0
C973	283-0632-00	B010100	B010126	CAP,FXD,MICA DI:87PF,1%,100V (SPG1 ONLY)	00853	D155E870F0

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
C973	283-0647-00	B010127		CAP,FXD,MICA DI:70PF,1%,100V (SPG1 ONLY)	00853	D155E700F0
C973	283-0632-00	B010100	B010437	CAP,FXD,MICA DI:87PF,1%,100V (SPG2 ONLY)	00853	D155E870F0
C973	283-0647-00	B010438		CAP,FXD,MICA DI:70PF,1%,100V (SPG2 ONLY)	00853	D155E700F0
C974	283-0625-00	B010100	B010126	CAP,FXD,MICA DI:220PF,1%,500V (SPG1 ONLY)	00853	D105F221F0
C974	283-0672-00	B010127		CAP,FXD,MICA DI:200PF,1%,500V (SPG1 ONLY)	00853	D155F2010F0
C974	283-0625-00	B010100	B010437	CAP,FXD,MICA DI:220PF,1%,500V (SPG2 ONLY)	00853	D105F221F0
C974	283-0672-00	B010438		CAP,FXD,MICA DI:200PF,1%,500V (SPG2 ONLY)	00853	D155F2010F0
C977	281-0526-00	B010100	B010126	CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V (SPG1 ONLY)	52763	2RDPLZ007 1P50DS
C977	281-0534-00	B010127		CAP,FXD,CER DI:3.3PF,+/-0.25PF,500V (SPG1 ONLY)	52763	2RDPLZ007 3P30CC
C977	281-0526-00	B010100	B010437	CAP,FXD,CER DI:1.5PF,+/-0.5PF,500V (SPG2 ONLY)	52763	2RDPLZ007 1P50DS
C977	281-0534-00	B010438		CAP,FXD,CER DI:3.3PF,+/-0.25PF,500V (SPG2 ONLY)	52763	2RDPLZ007 3P30CC
C981	283-0634-00	B010100	B010126	CAP,FXD,MICA DI:65PF,1%,100V (SPG1 ONLY)	00853	D155E650F0
C981	283-0677-00	B010127		CAP,FXD,MICA DI:82PF,1%,500V (SPG1 ONLY)	00853	D155E820F0
C981	283-0634-00	B010100	B010437	CAP,FXD,MICA DI:65PF,1%,100V (SPG2 ONLY)	00853	D155E650F0
C981	283-0677-00	B010438		CAP,FXD,MICA DI:82PF,1%,500V (SPG2 ONLY)	00853	D155E820F0
C982	283-0666-00			CAP,FXD,MICA DI:890PF,2%,100V	00853	D151F891G0
C983	283-0628-00	B010100	B010126	CAP,FXD,MICA DI:410PF,1%,500V (SPG1 ONLY)	00853	D155F411F0
C983	283-0698-00	B010127		CAP,FXD,MICA DI:390PF,1%,500V (SPG1 ONLY)	00853	D155F391F0
C983	283-0628-00	B010100	B010437	CAP,FXD,MICA DI:410PF,1%,500V (SPG2 ONLY)	00853	D155F411F0
C983	283-0698-00	B010438		CAP,FXD,MICA DI:390PF,1%,500V (SPG2 ONLY)	00853	D155F391F0
C984	283-0644-00			CAP,FXD,MICA DI:150PF,1%,500V	00853	D155F151F0
C985	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C985	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C985	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C985	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C986	283-0081-00	B010100	B010126	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG1 ONLY)	59821	2DDU69E104Z
C986	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C986	283-0081-00	B010100	B010437	CAP,FXD,CER DI:0.1UF,+80-20%,25V (SPG2 ONLY)	59821	2DDU69E104Z
C986	281-0775-00	B010438		CAP,FXD,CER DI:0.1UF,20%,50V (SPG2 ONLY)	04222	MA205E104MAA
C990	283-0636-00	B010127		CAP,FXD,MICA DI:36PF,1.4%,100V (SPG1 ONLY)	00853	D155E360G0
C990	283-0636-00	B010438		CAP,FXD,MICA DI:36PF,1.4%,100V (SPG2 ONLY)	00853	D155E360G0
C991	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C992	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C993	290-0745-00			CAP,FXD,ELCTLT:22UF,+50-10%,25V	54473	ECE-A25V22L
C994	281-0577-00	B010100	B010126	CAP,FXD,CER DI:14PF,5%,500V	52763	2RDPLZ007 14P0JC

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG1 ONLY)		
C994	283-0648-00	B010127		CAP,FXD,MICA DI:10PF,5%,500V (SPG1 ONLY)	00853	D155C10000
C994	281-0577-00	B010100	B010437	CAP,FXD,CER DI:14PF,5%,500V (SPG2 ONLY)	52763	2RDPLZ007 14P0JC
C994	283-0648-00	B010438		CAP,FXD,MICA DI:10PF,5%,500V (SPG2 ONLY)	00853	D155C10000
C995	281-0577-00	B010100	B010126	CAP,FXD,CER DI:14PF,5%,500V (SPG1 ONLY)	52763	2RDPLZ007 14P0JC
C995	283-0648-00	B010127		CAP,FXD,MICA DI:10PF,5%,500V (SPG1 ONLY)	00853	D155C10000
C995	281-0577-00	B010100	B010437	CAP,FXD,CER DI:14PF,5%,500V (SPG2 ONLY)	52763	2RDPLZ007 14P0JC
C995	283-0648-00	B010438		CAP,FXD,MICA DI:10PF,5%,500V (SPG2 ONLY)	00853	D155C10000
C996	283-0177-00	B010100	B010126	CAP,FXD,CER DI:1UF,+80-20%,25V (SPG1 ONLY)	04222	SR302E105ZAATR
C996	281-0775-00	B010127		CAP,FXD,CER DI:0.1UF,20%,50V (SPG1 ONLY)	04222	MA205E104MAA
C996	283-0177-00	B010100	B010437	CAP,FXD,CER DI:1UF,+80-20%,25V (SPG2 ONLY)	04222	SR302E105ZAATR
C996	283-0775-00	B010438		CAP,FXD,MICA DI:1764 PF,1%,500V (SPG2 ONLY)	00853	D195F17640F0
CR135	152-0141-02	B020000		SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR154	152-0269-00	B010100	B010162	SEMICOND DVC,DI:VVC,SI,35V,33PF,DO-7 (SPG1 ONLY)	04713	SMV1263
CR154	152-0269-01	B010163		SEMICOND DVC,DI:VVC,SI,33PF,5%,35V,DO-7 (SPG1 ONLY)	04713	SMV1263-1
CR154	152-0269-00	B010100	B010632	SEMICOND DVC,DI:VVC,SI,35V,33PF,DO-7 (SPG2 ONLY)	04713	SMV1263
CR154	152-0269-01	B010633		SEMICOND DVC,DI:VVC,SI,33PF,5%,35V,DO-7 (SPG2 ONLY)	04713	SMV1263-1
CR224	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR241	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR270	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR271	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR280	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR300	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR304	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR308	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR317	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR324	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR364	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR365	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR375	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR379	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR389	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR396	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR406	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR410	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR426	152-0141-02	B010580		SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR426	152-0141-02	B010140		SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG1 ONLY)	03508	DA2527 (1N4152)
CR429	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR453	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR476	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR480	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR483	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
CR546	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR563	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR571	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR573	152-0141-02	B010135		SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR660	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR661	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR680	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR685	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR699	----- -----			(SPG2 ONLY)		
CR699	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR708	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR729	152-0153-00			SEMICOND DVC,DI:SW,SI,10V,50MA,.DO-7 (SPG2 ONLY)	07263	FD7003
CR736	152-0153-00			SEMICOND DVC,DI:SW,SI,10V,50MA,.DO-7 (SPG2 ONLY)	07263	FD7003
CR861	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR862	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR871	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR883	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR901	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR933	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR941	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR943	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR952	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR953	152-0141-02	B010127		SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG1 ONLY)	03508	DA2527 (1N4152)
CR953	152-0141-02	B010438		SEMICOND DVC,DI:SW,SI,30V,150MA,30V (SPG2 ONLY)	03508	DA2527 (1N4152)
CR955	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
CR956	152-0141-02			SEMICOND DVC,DI:SW,SI,30V,150MA,30V	03508	DA2527 (1N4152)
L159	108-0088-00			COIL,RF:FIXED,3.35UH	TK1345	108-0088-00
L448	108-0317-00			COIL,RF:FIXED,15 UH	32159	71501M+10PERCENT
L589	108-0472-00			COIL,RF:FIXED,162UH (SPG2 ONLY)	80009	108-0472-00
L600	108-0472-00			COIL,RF:FIXED,162UH (SPG2 ONLY)	80009	108-0472-00
L606	108-0472-00			COIL,RF:FIXED,162UH (SPG2 ONLY)	80009	108-0472-00
L645	108-0231-00			COIL,RF:FIXED,4.5UH (SPG2 ONLY)	80009	108-0231-00
L656	108-0395-00			COIL,RF:FIXED,64UH (SPG2 ONLY)	80009	108-0395-00
L679	114-0332-00			COIL,RF:VARIABLE,12-20UH (SPG2 ONLY)	80009	114-0332-00
L734	108-0317-00			COIL,RF:FIXED,15 UH (SPG2 ONLY)	32159	71501M+10PERCENT
L777	108-0443-00			COIL,RF:FIXED,23.5UH	80009	108-0443-00
L863	114-0280-00			COIL,RF:VARIABLE,12-43UH	80009	114-0280-00
L911	114-0218-00	B010100	B010126	COIL,RF:VARIABLE,70-120UH (SPG1 ONLY)	80009	114-0218-00
L911	114-0219-00	B010127		COIL,RF:VARIABLE,45-130UH (SPG1 ONLY)	80009	114-0219-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
L911	114-0218-00	B010100	B010437	COIL,RF:VARIABLE,70-120UH (SPG2 ONLY)	80009	114-0218-00
L911	114-0219-00	B010438		COIL,RF:VARIABLE,45-130UH (SPG2 ONLY)	80009	114-0219-00
L923	114-0343-00			COIL,RF:VARIABLE,200-400UH	80009	114-0343-00
L933	114-0343-00			COIL,RF:VARIABLE,200-400UH	80009	114-0343-00
L938	114-0281-00	B010100	B010104	COIL,RF:VARIABLE,35-70UH (SPG1 ONLY)	80009	114-0281-00
L938	114-0280-00	B010105		COIL,RF:VARIABLE,12-43UH (SPG1 ONLY)	80009	114-0280-00
L938	114-0281-00	B010100	B010175	COIL,RF:VARIABLE,35-70UH (SPG2 ONLY)	80009	114-0281-00
L938	114-0280-00	B010176		COIL,RF:VARIABLE,12-43UH (SPG2 ONLY)	80009	114-0280-00
L948	114-0281-00	B010100	B010104	COIL,RF:VARIABLE,35-70UH (SPG1 ONLY)	80009	114-0281-00
L948	114-0280-00	B010105		COIL,RF:VARIABLE,12-43UH (SPG1 ONLY)	80009	114-0280-00
L948	114-0281-00	B010100	B010175	COIL,RF:VARIABLE,35-70UH (SPG2 ONLY)	80009	114-0281-00
L948	114-0280-00	B010176		COIL,RF:VARIABLE,12-43UH (SPG2 ONLY)	80009	114-0280-00
L971	114-0257-00			COIL,RF:VARIABLE,6-11UH	80009	114-0257-00
L974	114-0308-00			COIL,RF:VARIABLE,2.9-6.5UH	80009	114-0308-00
L981	114-0278-00	B010100	B010126	COIL,RF:VARIABLE,4.6-16.7UH (SPG1 ONLY)	80009	114-0278-00
L981	114-0303-00	B010127		COIL,RF:VARIABLE,6.5-23UH (SPG1 ONLY)	80009	114-0303-00
L981	114-0278-00	B010100	B010437	COIL,RF:VARIABLE,4.6-16.7UH (SPG2 ONLY)	80009	114-0278-00
L981	114-0303-00	B010438		COIL,RF:VARIABLE,6.5-23UH (SPG2 ONLY)	80009	114-0303-00
L984	114-0278-00			COIL,RF:VARIABLE,4.6-16.7UH	80009	114-0278-00
Q131	151-0402-00			TRANSISTOR:SELECTED	01295	SKA6814
Q132	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q133	151-0402-00	B010100	B019999	TRANSISTOR:SELECTED	01295	SKA6814
Q134	151-0220-00	B010100	B019999	TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q135	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q136	151-0402-00			TRANSISTOR:SELECTED	01295	SKA6814
Q137	151-0220-00	B010100	B019999	TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q138	151-0402-00	B010100	B019999	TRANSISTOR:SELECTED	01295	SKA6814
Q157	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q190	151-0221-00	B030000		TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
Q217	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q252	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q260	151-0192-00	B010100	B020167	TRANSISTOR:SELECTED (SPG1 ONLY)	04713	SPS8801
Q260	151-0223-00	B020168		TRANSISTOR:NPN,SI,TO-92 (SPG1 ONLY)	04713	SPS8026
Q260	151-0192-00	B010100	B020904	TRANSISTOR:SELECTED (SPG2 ONLY)	04713	SPS8801
Q260	151-0223-00	B020905		TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	04713	SPS8026
Q261	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q262	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q284	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q294	151-0254-00			TRANSISTOR:DARLINGTON,NPN,SI	03508	X38L3118
Q300	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q301	151-0207-00			TRANSISTOR:NPN,SI,X-55,SEL	57668	XD11BCP0207
Q304	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q305	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026
Q312	151-0223-00			TRANSISTOR:NPN,SI,TO-92	04713	SPS8026

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
Q314	151-0188-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0188-00
Q315	151-0192-00	B010100	B020167	TRANSISTOR:SELECTED (SPG1 ONLY)	04713	SPS8801
Q315	151-0223-00	B020168		TRANSISTOR:NPN,SI,TO-92 (SPG1 ONLY)	04713	SPS8026
Q315	151-0192-00	B010100	B020904	TRANSISTOR:SELECTED (SPG2 ONLY)	04713	SPS8801
Q315	151-0223-00	B020905		TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	04713	SPS8026
Q405	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
Q406	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q407	151-0410-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS6765
Q408	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
Q427	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
Q436	151-0216-00			TRANSISTOR:PNP,SI,TO-92	04713	SPS8803
Q460	151-0207-00			TRANSISTOR:NPN,SI,X-55,SEL (SPG2 ONLY)	57668	X0118CP0207
Q462	151-0410-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS6765
Q463	151-0410-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS6765
Q464	151-0207-00			TRANSISTOR:NPN,SI,X-55,SEL (SPG2 ONLY)	57668	X0118CP0207
Q465	151-0435-00			TRANSISTOR:DARLINGTON,PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS8335
Q469	151-0410-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS6765
Q470	151-0410-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS6765
Q474	151-0188-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	80009	151-0188-00
Q475	151-0164-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	2N2907A
Q489	151-0216-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS8803
Q538	151-1025-00			TRANSISTOR:FET,N-CHAN,SI,TO-92 (SPG2 ONLY)	04713	SPF3036
Q545	151-0188-00			TRANSISTOR:PNP,SI,TO-92 (BEGIN USAGE W/670-4449-07 SPG2 ONLY)	80009	151-0188-00
Q545	151-0325-00			TRANSISTOR:PNP,SI,TO-92,SEL (END USAGE W/670-4449-05 SPG2 ONLY)	80009	151-0325-00
Q545	151-0325-01			TRANSISTOR:SELECTED (ENDED USAGE W/670-4449-05 SPG2 ONLY)	TK0040	151-0325-01
Q550	151-0325-00	B010100	B021295	TRANSISTOR:PNP,SI,TO-92,SEL (SPG2 ONLY)	80009	151-0325-00
Q550	151-0325-01	B021296		TRANSISTOR:SELECTED (SPG2 ONLY)	TK0040	151-0325-01
Q554	151-1025-00			TRANSISTOR:FET,N-CHAN,SI,TO-92 (SPG2 ONLY)	04713	SPF3036
Q555	151-1025-00			TRANSISTOR:FET,N-CHAN,SI,TO-92 (SPG2 ONLY)	04713	SPF3036
Q560	151-0325-00	B010100	B021295	TRANSISTOR:PNP,SI,TO-92,SEL (SPG2 ONLY)	80009	151-0325-00
Q560	151-0325-01	B021296		TRANSISTOR:SELECTED (SPG2 ONLY)	TK0040	151-0325-01
Q565	151-0223-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	04713	SPS8026
Q569	151-0302-00			TRANSISTOR:NPN,SI,TO-18 (SPG2 ONLY)	04713	ST899
Q570	151-0325-00	B010100	B021295	TRANSISTOR:PNP,SI,TO-92,SEL (SPG2 ONLY)	80009	151-0325-00
Q570	151-0325-01	B021296		TRANSISTOR:SELECTED (SPG2 ONLY)	TK0040	151-0325-01

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
Q578	151-1005-00	B010100	B021295	TRANSISTOR:FET,N-CHAN,SI,TO-106 (SPG2 ONLY)	04713	SPF685
Q578	151-1005-01	B021296		TRANSISTOR:FET,N-CHAN,SI,TEK CHK (SPG2 ONLY)	80009	151-1005-01
Q590	151-0302-00			TRANSISTOR:NPN,SI,TO-18 (SPG2 ONLY)	04713	ST899
Q592	151-0216-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS8803
Q594	151-0302-00			TRANSISTOR:NPN,SI,TO-18 (SPG2 ONLY)	04713	ST899
Q595	151-0216-00			TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	04713	SPS8803
Q665	151-0190-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q666	151-0190-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q670	151-0188-00			TRANSISTOR:PNP,SI,TO-92 (BEGIN USAGE W/670-4449-07 SPG2 ONLY)	80009	151-0188-00
Q670	151-0325-01			TRANSISTOR:SELECTED (ENDED USAGE W/670-4449-05 SPG2 ONLY)	TK0040	151-0325-01
Q686	151-0441-00			TRANSISTOR:NPN,SI,TO-72 (SPG2 ONLY)	04713	SRF501
Q715	151-0190-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q718	151-0190-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q719	151-0190-00			TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q725	151-0367-00	B010100	B021295	TRANSISTOR:NPN,SI,X-55 (SPG2 ONLY)	04713	SPS 8811
Q725	151-0367-01	B021296		TRANSISTOR:SELECTED (SPG2 ONLY)	TK0040	151-0367-01
Q755	151-0221-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0221-00
Q767	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q768	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q775	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q776	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q784	151-0103-00			TRANSISTOR:NPN,SI,TO-5	04713	SM1307
Q875	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q876	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q878	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q880	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q897	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q898	151-0190-00			TRANSISTOR:NPN,SI,TO-92	80009	151-0190-00
Q903	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q915	151-0232-00			TRANSISTOR:NPN,SI,TO-78	07263	SP12141
Q941	151-0291-00			TRANSISTOR:NPN,SI,TO-3	02735	60156
Q942	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q942	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q944	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q951	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q954	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q955	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q962	151-0192-00			TRANSISTOR:SELECTED	04713	SPS8801
Q963	151-0192-00	B010100	B010126	TRANSISTOR:SELECTED (SPG1 ONLY)	04713	SPS8801
Q963	151-0192-00	B010100	B010437	TRANSISTOR:SELECTED (SPG2 ONLY)	04713	SPS8801
Q966	151-0459-00	B010100	B010126	TRANSISTOR:PNP,SI,TO-18 (SPG1 ONLY)	04713	ST1068
Q966	151-0220-00	B010127		TRANSISTOR:PNP,SI,TO-92 (SPG1 ONLY)	80009	151-0220-00

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
Q966	151-0459-00	B010100	B010437	TRANSISTOR:PNP,SI,TO-18 (SPG2 ONLY)	04713	ST1068
Q966	151-0220-00	B010438		TRANSISTOR:PNP,SI,TO-92 (SPG2 ONLY)	80009	151-0220-00
Q976	151-0460-00	B010100	B010126	TRANSISTOR:NPN,SI,TO-18 (SPG1 ONLY)	04713	2N3947
Q976	151-0190-00	B010127		TRANSISTOR:NPN,SI,TO-92 (SPG1 ONLY)	80009	151-0190-00
Q976	151-0460-00	B010100	B010437	TRANSISTOR:NPN,SI,TO-18 (SPG2 ONLY)	04713	2N3947
Q976	151-0190-00	B010438		TRANSISTOR:NPN,SI,TO-92 (SPG2 ONLY)	80009	151-0190-00
Q978	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q979	151-0220-00			TRANSISTOR:PNP,SI,TO-92	80009	151-0220-00
Q997	151-0103-00			TRANSISTOR:NPN,SI,TO-5	04713	SM1307
R101	315-0472-00	B020220		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E04K7
R101	315-0472-00	B021322		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R102	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E03K3
R102	315-0332-00	B010135		RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R103	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R104	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R105	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R106	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R107	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R108	315-0472-00	B020220		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E04K7
R108	315-0472-00	B021322		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R112	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R114	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R115	311-1915-00			RES,VAR,NONWW:TRMR,20K OHM,10%,0.5 W	32997	3386C-T07-203
R116	311-1915-00			RES,VAR,NONWW:TRMR,20K OHM,10%,0.5 W	32997	3386C-T07-203
R117	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R118	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R119	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R120	315-0202-00	B020190		RES,FXD,FILM:2K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E 2K
R120	315-0202-00	B021070		RES,FXD,FILM:2K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 2K
R124	315-0393-00	B010100	B019999	RES,FXD,FILM:39K OHM,5%,0.25W (NOMINAL VALUE, SELECTED)	57668	NTR25J-E39K0
R127	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
R128	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R130	315-0202-00	B020190		RES,FXD,FILM:2K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E 2K
R130	315-0202-00	B021070		RES,FXD,FILM:2K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 2K
R131	315-0472-00	B010137	B019999	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E04K7
R131	315-0472-00	B010331	B019999	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R132	315-0150-00			RES,FXD,FILM:15 OHM,5%,0.25W	19701	5043CX15R00J
R133	315-0150-00	B010100	B019999	RES,FXD,FILM:15 OHM,5%,0.25W	19701	5043CX15R00J
R134	315-0181-00			RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
R135	315-0181-00	B010100	B019999	RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
R135	315-0102-00	B020000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R136	315-0150-00			RES,FXD,FILM:15 OHM,5%,0.25W	19701	5043CX15R00J
R137	315-0150-00	B010100	B019999	RES,FXD,FILM:15 OHM,5%,0.25W	19701	5043CX15R00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R138	315-0181-00	B010100	B019999	RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
R139	315-0181-00	B010100	B029999	RES,FXD,FILM:180 OHM,5%,0.25W	57668	NTR25J-E180E
R140	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R141	315-0102-00	B010137	B019999	RES,FXD,FILM:1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25JE01K0
R141	315-0102-00	B010331	B019999	RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R141	315-0472-00	B020000		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R142	315-0393-00	B010100	B019999	RES,FXD,FILM:39K OHM,5%,0.25W (NOMINAL VALUE,SELECTED)	57668	NTR25J-E39K0
R143	315-0393-00	B010100	B019999	RES,FXD,FILM:39K OHM,5%,0.25W (NOMINAL VALUE,SELECTED)	57668	NTR25J-E39K0
R144	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R145	315-0470-00	B010100	B019999	RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R146	321-0360-00	B010100	B010136	RES,FXD,FILM:54.9K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	19701	5033ED54K90F
R146	321-0335-00	B010137	B019999	RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	57668	RB14FXE30K1
R146	321-0360-00	B010100	B010330	RES,FXD,FILM:54.9K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	19701	5033ED54K90F
R146	321-0335-00	B010331	B019999	RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	57668	RB14FXE30K1
R146	321-0327-00	B020000		RES,FXD,FILM:24.9K OHM,1%,0.125W,TC=T0	07716	CEAD24901F
R147	321-0289-00			RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=T0	19701	5033ED10K0F
R148	311-1914-00			RES,VAR,NONWW:TRMR,50K OHM,10%,0.5 W	32997	3386C-T07-503
R149	311-1916-00	B010100	B019999	RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R149	311-1917-00	B020000		RES,VAR,NONWW:TRMR,5K OHM,10%,0.5 W	32997	3386C-T07-502
R150	315-0100-00	B010100	B019999	RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R151	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R152	315-0151-00			RES,FXD,FILM:150 OHM,5%,0.25W	57668	NTR25J-E150E
R153	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R154	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R155	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R156	315-0272-00	B010100	B010136	RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E02K7
R156	315-0202-00	B010137	B019999	RES,FXD,FILM:2K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E 2K
R156	315-0272-00	B010100	B010330	RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E02K7
R156	315-0202-00	B010331	B019999	RES,FXD,FILM:2K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 2K
R156	315-0472-00	B020000		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R157	315-0621-00			RES,FXD,FILM:620 OHM,5%,0.25W	57668	NTR25J-E620E
R158	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R159	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R160	315-0272-00	B010137	B019999	RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E02K7
R160	315-0272-00	B010331	B019999	RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E02K7
R160	315-0472-00	B020000		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R161	315-0102-00	B010137		RES,FXD,FILM:1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25JE01K0
R161	315-0102-00	B010331		RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R162	315-0472-00	B020000		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R163	315-0102-00	B020220		RES,FXD,FILM:1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25JE01K0
R163	315-0102-00	B021322		RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R165	321-0335-00			RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0	57668	RB14FXE30K1
R166	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W	19701	5043CX30K00J
R167	315-0100-00	B010100	B010136	RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG1 ONLY)		
R167	315-0272-00	B010137		RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E02K7
R167	315-0100-00	B010100	B010330	RES,FXD,FILM:10 OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10RR00J
R167	315-0272-00	B010331		RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E02K7
R169	311-1914-00			RES,VAR,NONWW:TRMR,50K OHM,10%,0.5 W	32997	3386C-T07-503
R175	311-1750-00			RES,VAR,NONWW:TRMR,10K OHM,0.75W	02111	43P103T652
R176	315-0103-00	B030000		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R177	315-0472-00	B030000		RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R178	315-0103-00	B030000		RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R179	315-0102-00	B030000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R180	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R181	315-0102-00	B030000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R182	315-0102-00	B030000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R183	315-0102-00	B030000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R184	315-0512-00	B030000		RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R185	315-0102-00	B030000		RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R187	315-0223-00	B030000		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R188	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	19701	5033ED1K00F
R189	311-1918-00			RES,VAR,NONWW:TRMR,2K OHM,10%,0.5 W	32997	3386C-T07-202
R190	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R196	321-0164-00			RES,FXD,FILM:499 OHM,1%,0.125W,TC=T0	19701	5033ED499R0F
R197	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R198	311-1919-00			RES,VAR,NONWW:TRMR,1K OHM,10%,0.5 W	32997	3386C-T07-102
R199	311-1919-00			RES,VAR,NONWW:TRMR,1K OHM,10%,0.5 W	32997	3386C-T07-102
R202	321-0222-00	B010100	B029999	RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R202	315-0223-00	B030000		RES,FXD,FILM:22K OHM,5%,0.25W	19701	5043CX22K00J92U
R204	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R207	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5033ED4K020F
R208	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R209	311-1918-00			RES,VAR,NONWW:TRMR,2K OHM,10%,0.5 W	32997	3386C-T07-202
R210	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R211	315-0224-00			RES,FXD,FILM:220K OHM,5%,0.25W	57668	NTR25J-E220K
R214	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R215	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R216	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R217	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R218	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
R219	311-1915-00			RES,VAR,NONWW:TRMR,20K OHM,10%,0.5 W	32997	3386C-T07-203
R225	315-0622-00			RES,FXD,FILM:6.2K OHM,5%,0.25W	19701	5043CX6K200J
R226	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R227	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R244	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
R250	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R251	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W	57668	NTR25J-E47K0
R252	315-0226-00			RES,FXD,FILM:22M OHM,5%,0.25W	80009	315-0226-00
R253	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R254	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R260	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R261	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R262	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R263	315-0123-00			RES,FXD,FILM:12K OHM,5%,0.25W	57668	NTR25J-E12K0
R264	315-0432-00			RES,FXD,FILM:4.3K OHM,5%,0.25W	57668	NTR25J-E04K3
R265	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R269	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R270	321-0298-00			RES,FXD,FILM:12.4K OHM,1%,0.125W,TC=T0	07716	CEAD12401F
R271	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R272	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
R273	321-0270-00			RES,FXD,FILM:6.34K OHM,1%,0.125W,TC=T0	19701	5043ED6K340F
R274	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R275	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W	57668	NTR25J-E02K7
R276	311-1915-00			RES,VAR,NONWW:TRMR,20K OHM,10%,0.5 W	32997	3386C-T07-203
R277	315-0472-00	B010100	B010136	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E04K7
R277	315-0472-00	B010100	B010559	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R280	315-0221-00			RES,FXD,FILM:220 OHM,5%,0.25W	57668	NTR25J-E220E
R281	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R282	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R283	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R284	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R285	321-0335-00			RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0	57668	RB14FXE30K1
R290	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R291	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R293	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R294	315-0224-00			RES,FXD,FILM:220K OHM,5%,0.25W	57668	NTR25J-E220K
R295	315-0226-00			RES,FXD,FILM:22M OHM,5%,0.25W	80009	315-0226-00
R296	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R298	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R300	315-0222-00			RES,FXD,FILM:2.2K OHM,5%,0.25W	57668	NTR25J-E02K2
R304	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R305	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R306	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R307	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W	19701	5043CX1M000J
R308	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R310	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R312	321-0298-00			RES,FXD,FILM:12.4K OHM,1%,0.125W,TC=T0	07716	CEA012401F
R313	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R314	315-0242-00			RES,FXD,FILM:2.4K OHM,5%,0.25W	57668	NTR25J-E02K4
R315	321-0231-00			RES,FXD,FILM:2.49K OHM,1%,0.125W,TC=T0	19701	5033ED2K49F
R316	321-0298-00			RES,FXD,FILM:12.4K OHM,1%,0.125W,TC=T0	07716	CEA012401F
R317	321-0270-00			RES,FXD,FILM:6.34K OHM,1%,0.125W,TC=T0	19701	5043ED6K340F
R324	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
R326	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R327	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R328	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W	57668	NTR25J-E470E
R329	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R334	315-0301-00			RES,FXD,FILM:300 OHM,5%,0.25W	57668	NTR25J-E300E
R335	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
R336	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R338	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R339	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R362	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R364	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R365	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R366	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R372	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R373	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R374	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R375	315-0301-00			RES,FXD,FILM:300 OHM,5%,0.25W	57668	NTR25J-E300E
R376	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R377	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R378	315-0301-00			RES,FXD,FILM:300 OHM,5%,0.25W	57668	NTR25J-E300E
R379	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R382	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R384	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R387	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R388	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R389	315-0301-00			RES,FXD,FILM:300 OHM,5%,0.25W	57668	NTR25J-E300E
R390	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R391	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R392	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R395	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W	57668	NTR25J-E100K
R396	321-0393-00			RES,FXD,FILM:121K OHM,1%,0.125W,TC=T0	19701	5043ED121K0F
R397	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R398	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R400	315-0224-00			RES,FXD,FILM:220K OHM,5%,0.25W	57668	NTR25J-E220K
R401	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R402	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R403	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R404	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R405	321-0259-00			RES,FXD,FILM:4.87K OHM,1%,0.125W,TC=T0	07716	CEAD48700F
R406	315-0753-00			RES,FXD,FILM:75K OHM,5%,0.25W	57668	NTR25J-E75K0
R407	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R408	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R409	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R410	321-0338-00			RES,FXD,FILM:32.4K OHM,1%,0.125W,TC=T0	19701	5033ED32K40F
R411	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R412	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25W	57668	NTR25J-E01K5
R413	321-0331-00			RES,FXD,FILM:27.4K OHM,1%,0.125W,TC=T0	19701	5043ED27K40F
R414	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R416	321-0426-00			RES,FXD,FILM:267K OHM,1%,0.125W,TC=T0	07716	CEAD26702F
R420	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R425	315-0104-00	B010100	B010139	RES,FXD,FILM:100K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E100K
R425	315-0204-00	B010140		RES,FXD,FILM:200K OHM,5%,0.25W (SPG1 ONLY)	19701	5043CX200K0J
R425	315-0104-00	B010100	B010579	RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R425	315-0204-00	B010580		RES,FXD,FILM:200K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX200K0J
R426	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R427	315-0102-00	B010100	B010139	RES,FXD,FILM:1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25JE01K0
R427	315-0202-00	B010140		RES,FXD,FILM:2K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E 2K
R427	315-0102-00	B010100	B010579	RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R427	315-0202-00	B010580		RES,FXD,FILM:2K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 2K
R428	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R429	315-0473-00	B010140		RES,FXD,FILM:47K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E47K0
R429	315-0473-00	B010580		RES,FXD,FILM:47K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47K0
R437	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R438	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R439	315-0270-00			RES,FXD,FILM:27 OHM,5%,0.25W	19701	5043CX27R00J
R446	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R447	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W	19701	5043CX15K00J
R450	315-0622-00			RES,FXD,FILM:6.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX6K200J
R451	315-0152-00			RES,FXD,FILM:1.5K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E01K5
R453	315-0753-00			RES,FXD,FILM:75K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E75K0
R456	311-1338-00			RES,VAR,NONWW:TRMR,20K OHM,0.75W	02111	43P203T672

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
R459	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E24K0
R465	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R467	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R468	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R469	315-0751-00			RES,FXD,FILM:750 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E750E
R471	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX470K0J92U
R472	315-0272-00			RES,FXD,FILM:2.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E02K7
R474	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 2K
R476	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R477	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47K0
R478	315-0123-00			RES,FXD,FILM:12K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E12K0
R479	315-0243-00			RES,FXD,FILM:24K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E24K0
R480	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R481	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R483	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R484	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R486	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R487	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R488	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX1M000J
R490	315-0513-00			RES,FXD,FILM:51K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E51K0
R491	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX470K0J92U
R492	315-0101-00	B010135		RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R493	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R520	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R521	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47K0
R532	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47K0
R537	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R539	315-0181-00			RES,FXD,FILM:180 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E180E
R543	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R544	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R545	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R546	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R549	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R550	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E33K0
R552	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX470K0J92U
R554	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R556	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R559	315-0303-00			RES,FXD,FILM:30K OHM,5%,0.25W (BEGIN USAGE W/670-4449-07 SPG2 ONLY)	19701	5043CX30K00J
R560	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R562	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E05K1
R564	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R565	315-0474-00			RES,FXD,FILM:470K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX470K0J92U
R566	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX1M000J
R567	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R568	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R569	315-0822-00			RES,FXD,FILM:8.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX8K200J
R570	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R571	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R573	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R574	315-0822-00			RES,FXD,FILM:8.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX8K200J
R575	315-0104-00			RES,FXD,FILM:100K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E100K
R576	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R577	315-0822-00			RES,FXD,FILM:8.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX8K200J
R578	315-0362-00			RES,FXD,FILM:3.6K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX3K600J
R579	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R582	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R583	315-0362-00			RES,FXD,FILM:3.6K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX3K600J
R584	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R585	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R586	315-0362-00			RES,FXD,FILM:3.6K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX3K600J
R587	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R588	315-0361-00			RES,FXD,FILM:360 OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX360R0J
R594	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
R595	315-0361-00			RES,FXD,FILM:360 OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX360R0J
R602	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R603	315-0361-00			RES,FXD,FILM:360 OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX360R0J
R607	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E1K8
R608	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R609	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R610	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R615	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E1K8
R616	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E1K8
R617	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R621	315-0822-00			RES,FXD,FILM:8.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX8K200J
R622	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R623	315-0682-00			RES,FXD,FILM:6.8K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E06K8
R624	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R625	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R629	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R633	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R634	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R635	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R636	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R637	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R639	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R641	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R642	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R643	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R646	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E 100E
R649	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R654	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R655	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R656	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R657	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R658	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R659	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R660	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E33K0
R663	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R665	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R666	315-0472-00	B010100	B010134	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R666	315-0472-00	B010135		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY. NOMINAL VALUE,SELECTED)	57668	NTR25J-E04K7
R668	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R672	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R673	315-0333-00			RES,FXD,FILM:33K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E33K0
R674	321-0349-00			RES,FXD,FILM:42.2K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD42201F
R675	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E07K5
R676	315-0105-00			RES,FXD,FILM:1M OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX1M000J
R680	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R683	315-0432-00			RES,FXD,FILM:4.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K3
R684	315-0103-00	B010100	B010199	RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R684	315-0822-00	B010200		RES,FXD,FILM:8.2K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX8K200J
R689	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R693	315-0473-00			RES,FXD,FILM:47K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47K0
R698	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R699	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R703	321-0327-00			RES,FXD,FILM:24.9K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD24901F
R704	321-0452-00			RES,FXD,FILM:499K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	19701	5043ED499K0F
R707	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W (SPG2 ONLY)	32997	3386C-T07-103
R709	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E07K5
R715	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R716	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E03K3
R718	315-0472-00	B010100	B010134	RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E04K7
R718	315-0472-00	B010135		RES,FXD,FILM:4.7K OHM,5%,0.25W (SPG2 ONLY. NOMINAL VALUE,SELECTED)	57668	NTR25J-E04K7
R723	315-0391-00			RES,FXD,FILM:390 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E390E
R724	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E07K5
R725	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W	57668	NTR25J-E07K5

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG2 ONLY)		
R726	315-0471-00			RES,FXD,FILM:470 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E470E
R733	315-0430-00			RES,FXD,FILM:43 OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX43R00J
R736	315-0752-00			RES,FXD,FILM:7.5K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E07K5
R738	315-0153-00			RES,FXD,FILM:15K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX15K00J
R739	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R749	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W (SPG2 ONLY)	32997	3386C-T07-103
R755	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R756	315-0331-00			RES,FXD,FILM:330 OHM,5%,0.25W	57668	NTR25J-E330E
R757	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R758	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R765	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R767	321-0301-00			RES,FXD,FILM:13.3K OHM,1%,0.125W,TC=T0	07716	CEAD13301F
R768	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R775	321-0293-00			RES,FXD,FILM:11.0K OHM,1%,0.125W,TC=T0	07716	CEAD11001F
R776	315-0182-00			RES,FXD,FILM:1.8K OHM,5%,0.25W	57668	NTR25J-E1K8
R777	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5033ED4K020F
R784	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R785	321-0235-00			RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0	07716	CEAD27400F
R786	308-0243-00			RES,FXD,WW:240 OHM,5%,3W (SPG1 ONLY)	14193	SA31-2400J
R786	308-0299-00	B010100	B010134	RES,FXD,WW:300 OHM,1%,3W (SPG2 ONLY)	01686	T2A-300R-F-10
R786	308-0243-00	B010135		RES,FXD,WW:240 OHM,5%,3W (SPG2 ONLY)	14193	SA31-2400J
R787	321-0235-00			RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0	07716	CEAD27400F
R788	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125W,TC=T0	24546	NA55D7501F
R789	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R791	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R796	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R797	321-0085-00			RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0	57668	CRB14FXE 75 OHM
R798	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R800	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R801	321-0085-00			RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0	57668	CRB14FXE 75 OHM
R802	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R803	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R804	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R805	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R806	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R807	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R810	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R812	315-0472-00			RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J-E04K7
R816	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	19701	5043ED6K980F
R818	321-0280-00			RES,FXD,FILM:8.06K OHM,1%,0.125W,TC=T0	19701	5033ED8K060F
R820	321-0318-00			RES,FXD,FILM:20.0K OHM,1%,0.125W,TC=T0	19701	5033ED20K00F
R821	311-1916-00			RES,VAR,NONWW:TRMR,10K OHM,10%,0.5 W	32997	3386C-T07-103
R823	321-0280-00			RES,FXD,FILM:8.06K OHM,1%,0.125W,TC=T0	19701	5033ED8K060F
R824	321-0274-00			RES,FXD,FILM:6.98K OHM,1%,0.125W,TC=T0	19701	5043ED6K980F
R825	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R833	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R834	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R835	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R838	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J
R839	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R842	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R843	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R844	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R845	322-0085-00			RES,FXD,FILM:75.0 OHM,1%,0.25W,TC=T0	75042	CEBT0-75R00F
R850	315-0103-00	B020211		RES,FXD,FILM:10K OHM,5%,0.25W (SPG1 ONLY)	19701	5043CX10K00J
R850	315-0103-00	B021237		RES,FXD,FILM:10K OHM,5%,0.25W (SPG2 ONLY)	19701	5043CX10K00J
R852	315-0751-00			RES,FXD,FILM:750 OHM,5%,0.25W	57668	NTR25J-E750E
R854	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R855	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R856	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R857	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R858	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R859	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R861	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R865	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R866	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R868	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R869	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R870	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R871	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R872	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	19701	5033ED1K00F
R873	321-0222-00			RES,FXD,FILM:2.00K OHM,1%,0.125W,TC=T0	19701	5033ED2K00F
R874	321-0260-00			RES,FXD,FILM:4.99K OHM,1%,0.125W,TC=T0	19701	5033ED4K990F
R877	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R880	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R882	321-0289-00			RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=T0	19701	5033ED10K0F
R883	315-0512-00	B010100	B010126	RES,FXD,FILM:5.1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E05K1
R883	315-0751-00	B010127		RES,FXD,FILM:750 OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E750E
R883	315-0512-00	B010100	B010437	RES,FXD,FILM:5.1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E05K1
R883	315-0751-00	B010438		RES,FXD,FILM:750 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E750E
R884	315-0512-00			RES,FXD,FILM:5.1K OHM,5%,0.25W	57668	NTR25J-E05K1
R885	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
R886	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R887	315-0392-00			RES,FXD,FILM:3.9K OHM,5%,0.25W	57668	NTR25J-E03K9
R888	315-0202-00			RES,FXD,FILM:2K OHM,5%,0.25W	57668	NTR25J-E 2K
R889	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R892	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R893	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R894	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R895	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R902	321-1705-04			RES,FXD,FILM:13.05K OHM,0.1%,0.125W,TC=T2	19701	5033RC13K05B
R904	311-1918-00			RES,VAR,NONWW:TRMR,2K OHM,10%,0.5 W	32997	3386C-T07-202
R905	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R906	315-0332-00			RES,FXD,FILM:3.3K OHM,5%,0.25W	57668	NTR25J-E03K3
R908	321-0154-00	B010100	B010126	RES,FXD,FILM:392 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEA0392R0F
R908	321-0126-00	B010127		RES,FXD,FILM:200 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	19701	5033ED200R0F
R908	321-0154-00	B010100	B010437	RES,FXD,FILM:392 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEA0392R0F
R908	321-0126-00	B010438		RES,FXD,FILM:200 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	19701	5033ED200R0F
R911	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	19701	5033ED1K00F
R912	315-0100-00			RES,FXD,FILM:10 OHM,5%,0.25W	19701	5043CX10RR00J

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R913	321-0696-00			RES,FXD,FILM:40.2K OHM,0.5%,0.125W,TC=T2	19701	5033RC40K20D
R914	321-0696-00			RES,FXD,FILM:40.2K OHM,0.5%,0.125W,TC=T2	19701	5033RC40K20D
R917	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R919	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R921	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R926	321-0193-00			RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0	19701	5033ED1K00F
R927	315-0103-00			RES,FXD,FILM:10K OHM,5%,0.25W	19701	5043CX10K00J
R928	315-0101-00			RES,FXD,FILM:100 OHM,5%,0.25W	57668	NTR25J-E 100E
R929	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R931	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R932	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R933	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R934	321-0991-03			RES,FXD,FILM:18K OHM,0.25%,0.125W,TC=T2	24546	NC55C1802C
R941	321-0358-00			RES,FXD,FILM:52.3K OHM,1%,0.125W,TC=T0	07716	CEAD52301F
R942	315-0185-00			RES,FXD,FILM:1.8M OHM,5%,0.25W	01121	CB1855
R943	321-0327-02			RES,FXD,FILM:24.9K OHM,0.5%,0.125W,TC=T2	24546	NC55C2492D
R948	321-0193-00	B010100	B010104	RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	19701	5033ED1K00F
R948	321-0126-00	B010105		RES,FXD,FILM:200 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	19701	5033ED200R0F
R948	321-0193-00	B010100	B010175	RES,FXD,FILM:1K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	19701	5033ED1K00F
R948	321-0126-00	B010176		RES,FXD,FILM:200 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	19701	5033ED200R0F
R950	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R951	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R952	315-0102-00	B010127		RES,FXD,FILM:1K OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25JE01K0
R952	315-0102-00	B010438		RES,FXD,FILM:1K OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25JE01K0
R953	321-0399-00			RES,FXD,FILM:140K OHM,1%,0.125W,TC=T0	07716	CEAD14002F
R954	321-0329-02			RES,FXD,FILM:26.1K OHM,0.5%,0.125W,TC=T2	19701	5033RC26K10D
R955	321-0399-00			RES,FXD,FILM:140K OHM,1%,0.125W,TC=T0	07716	CEAD14002F
R956	315-0102-00			RES,FXD,FILM:1K OHM,5%,0.25W	57668	NTR25JE01K0
R958	311-1919-00	B010100	B010104	RES,VAR,NONWW:TRMR,1K OHM,10%,0.5 W (SPG1 ONLY)	32997	3386C-T07-102
R958	311-1244-00	B010105		RES,VAR,NONWW:TRMR,100 OHM,0.5W (SPG1 ONLY)	32997	3386X-T07-101
R958	311-1919-00	B010100	B010175	RES,VAR,NONWW:TRMR,1K OHM,10%,0.5 W (SPG2 ONLY)	32997	3386C-T07-102
R958	311-1244-00	B010176		RES,VAR,NONWW:TRMR,100 OHM,0.5W (SPG2 ONLY)	32997	3386X-T07-101
R960	315-0470-00	B010100	B010126	RES,FXD,FILM:47 OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E47E0
R960	315-0470-00	B010100	B010437	RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R961	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R962	321-0335-00	B010100	B010126	RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	57668	RB14FXE30K1
R962	321-0335-00	B010100	B010437	RES,FXD,FILM:30.1K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	57668	RB14FXE30K1
R963	315-0470-00			RES,FXD,FILM:47 OHM,5%,0.25W	57668	NTR25J-E47E0
R964	321-0289-00			RES,FXD,FILM:10.0K OHM,1%,0.125W,TC=T0	19701	5033ED10K0F
R965	321-0251-00			RES,FXD,FILM:4.02K OHM,1%,0.125W,TC=T0	19701	5033ED4K020F
R966	315-0622-00			RES,FXD,FILM:6.2K OHM,5%,0.25W	19701	5043CX6K200J
R967	321-0235-00	B010100	B010126	RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD27400F
R967	321-0240-00	B010127		RES,FXD,FILM:3.09K OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD30900F
R967	321-0235-00	B010100	B010437	RES,FXD,FILM:2.74K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD27400F

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
R967	321-0240-00	B010438		RES,FXD,FILM:3.09K OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD30900F
R968	321-0181-00	B010100	B010104	RES,FXD,FILM:750 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD750R0F
R968	321-0118-00	B010105		RES,FXD,FILM:165 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD165R0F
R968	321-0181-00	B010100	B010175	RES,FXD,FILM:750 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD750R0F
R968	321-0118-00	B010176		RES,FXD,FILM:165 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD165R0F
R969	311-1920-00	B010100	B010126	RES,VAR,NONWW:TRMR,500 OHM,10%,0.5 W (SPG1 ONLY)	32997	3386C-T07-501
R969	311-1248-00	B010127		RES,VAR,NONWW:TRMR,500 OHM,0.5W (SPG1 ONLY)	32997	3386X-T07-501
R969	311-1920-00	B010100	B010437	RES,VAR,NONWW:TRMR,500 OHM,10%,0.5 W (SPG2 ONLY)	32997	3386C-T07-501
R969	311-1248-00	B010438		RES,VAR,NONWW:TRMR,500 OHM,0.5W (SPG2 ONLY)	32997	3386X-T07-501
R974	321-0117-00			RES,FXD,FILM:162 OHM,1%,0.125W,TC=T0	07716	CEAD162R0F
R975	321-0256-00			RES,FXD,FILM:4.53K OHM,1%,0.125W,TC=T9	19701	5033ED4K530F
R977	321-0188-00	B010100	B010126	RES,FXD,FILM:887 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD887R0F
R977	321-0191-00	B010127		RES,FXD,FILM:953 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	07716	CEAD953R0F
R977	321-0188-00	B010100	B010437	RES,FXD,FILM:887 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD887R0F
R977	321-0191-00	B010438		RES,FXD,FILM:953 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	07716	CEAD953R0F
R978	311-1921-00	B010100	B010126	RES,VAR,NONWW:TRMR,250 OHM,10%,0.5 W (SPG1 ONLY)	32997	3386C-T07-251
R978	311-1244-00	B010127		RES,VAR,NONWW:TRMR,100 OHM,0.5W (SPG1 ONLY)	32997	3386X-T07-101
R978	311-1921-00	B010100	B010437	RES,VAR,NONWW:TRMR,250 OHM,10%,0.5 W (SPG2 ONLY)	32997	3386C-T07-251
R978	311-1244-00	B010438		RES,VAR,NONWW:TRMR,100 OHM,0.5W (SPG2 ONLY)	32997	3386X-T07-101
R984	321-0117-00			RES,FXD,FILM:162 OHM,1%,0.125W,TC=T0	07716	CEAD162R0F
R985	315-0470-00	B010100	B010126	RES,FXD,FILM:47 OHM,5%,0.25W (SPG1 ONLY)	57668	NTR25J-E47E0
R985	315-0470-00	B010100	B010437	RES,FXD,FILM:47 OHM,5%,0.25W (SPG2 ONLY)	57668	NTR25J-E47E0
R986	315-0302-00			RES,FXD,FILM:3K OHM,5%,0.25W	57668	NTR25J-E03K0
R987	315-0681-00			RES,FXD,FILM:680 OHM,5%,0.25W	57668	NTR25J-E680E
R988	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125W,TC=T0	24546	NA55D7501F
R989	321-0277-00			RES,FXD,FILM:7.50K OHM,1%,0.125W,TC=T0	24546	NA55D7501F
R996	321-0085-00	B010100	B020210	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	57668	CRB14FXE 75 OHM
R996	321-0085-03	B020211		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2 (SPG1 ONLY)	57668	CRB14 CYE 75 OHM
R996	321-0085-00	B010100	B021236	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	57668	CRB14FXE 75 OHM
R996	321-0085-03	B021237		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2 (SPG2 ONLY)	57668	CRB14 CYE 75 OHM
R997	321-0085-00	B010100	B020210	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	57668	CRB14FXE 75 OHM
R997	321-0085-03	B020211		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2 (SPG1 ONLY)	57668	CRB14 CYE 75 OHM
R997	321-0085-00	B010100	B021236	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	57668	CRB14FXE 75 OHM
R997	321-0085-03	B021237		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2 (SPG2 ONLY)	57668	CRB14 CYE 75 OHM
R998	321-0085-00	B010127	B020210	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG1 ONLY)	57668	CRB14FXE 75 OHM
R998	321-0085-03	B020211		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2	57668	CRB14 CYE 75 OHM

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG1 ONLY)		
R998	321-0085-00	B010438	B021236	RES,FXD,FILM:75 OHM,1%,0.125W,TC=T0 (SPG2 ONLY)	57668	CRB14FXE 75 OHM
R998	321-0085-03	B021237		RES,FXD,FILM:75 OHM,0.25%,0.125W,TC=T2 (SPG2 ONLY)	57668	CRB14 CYE 75 OHM
R999	308-0426-00			RES,FXD,WW:470 OHM,5%,3W	00213	1240S-470-5
S109	260-1589-00			SWITCH,ROCKER:(6)SPST,125MA,30VDC	81073	76SB06S
S200	260-2126-00	B030000		SWITCH,ROTARY:MEMORY SELECTOR	80009	260-2126-00
S362	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5 MM,W/2 CONTACTS	80009	263-0010-00
S366	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5 MM,W/2 CONTACTS	80009	263-0010-00
S368	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5 MM,W/2 CONTACTS	80009	263-0010-00
S854	260-1132-00	B010100	B010126	SWITCH,PUSH:DPDT,1A,28VDC,1 BUTTON (SPG1 ONLY)	80009	260-1132-00
S854	260-1224-00	B010127		SWITCH,PUSH:1 BUTTON,2 POLE,EXT ATTEN (SPG1 ONLY)	31918	ORDER BY DESCR
S854	260-1132-00	B010100	B010424	SWITCH,PUSH:DPDT,1A,28VDC,1 BUTTON (SPG2 ONLY)	80009	260-1132-00
S854	260-1224-00	B010425		SWITCH,PUSH:1 BUTTON,2 POLE,EXT ATTEN (SPG2 ONLY)	31918	ORDER BY DESCR
S858	260-1132-00	B010100	B010126	SWITCH,PUSH:DPDT,1A,28VDC,1 BUTTON (SPG1 ONLY)	80009	260-1132-00
S858	260-1224-00	B010127		SWITCH,PUSH:1 BUTTON,2 POLE,EXT ATTEN (SPG1 ONLY)	31918	ORDER BY DESCR
S858	260-1132-00	B010100	B010424	SWITCH,PUSH:DPDT,1A,28VDC,1 BUTTON (SPG2 ONLY)	80009	260-1132-00
S858	260-1224-00	B010425		SWITCH,PUSH:1 BUTTON,2 POLE,EXT ATTEN (SPG2 ONLY)	31918	ORDER BY DESCR
T908	120-1071-00			TRANSFORMER,RF:TOROID	80009	120-1071-00
T928	120-1070-00			TRANSFORMER,RF:TOROID	80009	120-1070-00
U101	156-0784-00	B020220	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U101	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U101	156-0784-00	B021322	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U101	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U102	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U106	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U106	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U106	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U106	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U107	156-0785-04	B010100	B020219	MICROCKT,DGTL:PROM,PROGRAMMED (SPG1 ONLY)	80009	156-0785-04
U107	156-0785-19	B020220		MICROCKT,DGTL:256 BIT PROM PROGRAMMED (SPG1 ONLY)	80009	156-0785-19
U107	156-0785-04	B010100	B021321	MICROCKT,DGTL:PROM,PROGRAMMED (SPG2 ONLY)	80009	156-0785-04
U107	156-0785-19	B021322		MICROCKT,DGTL:256 BIT PROM PROGRAMMED (SPG2 ONLY)	80009	156-0785-19
U110	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U112	156-0043-03			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U113	156-0385-02			MICROCKT,DGTL:HEX INVERTER	07263	74LS04PCQR
U115	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U121	156-0504-00			MICROCKT,DGTL:HEX BUFFER	02735	CD4010BF
U122	156-0504-00			MICROCKT,DGTL:HEX BUFFER	02735	CD4010BF
U126	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U128	156-0786-02	B010100	B019999	MICROCKT,DGTL:QUAD EXCLUSIVE OR GATE,SCRN	02735	CD4070BFX

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
U129	155-0147-00	B010100	B010132	MICROCKT,DGTL:CIRCUIT TV GEN (SPG1 ONLY)	80009	155-0147-00
U129	155-0147-02	B010133	B019999	MICROCKT,DGTL:CIRCUIT TV GEN (SPG1 ONLY)	80009	155-0147-02
U129	155-0147-00	B010100	B010519	MICROCKT,DGTL:CIRCUIT TV GEN (SPG2 ONLY)	80009	155-0147-00
U129	155-0147-02	B010520	B019999	MICROCKT,DGTL:CIRCUIT TV GEN (SPG2 ONLY)	80009	155-0147-02
U129	155-0188-00	B020000		MICROCKT,DGTL:SYNC GENERATOR	31471	2610-001
U131	156-0504-00			MICROCKT,DGTL:HEX BUFFER	02735	CD40108F
U132	156-0385-02			MICROCKT,DGTL:HEX INVERTER	07263	74LS04PCQR
U140	156-0504-00			MICROCKT,DGTL:HEX BUFFER	02735	CD40108F
U141	156-0043-03			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U142	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U142	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U142	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U142	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U145	156-0786-02	B010100	B019999	MICROCKT,DGTL:QUAD EXCLUSIVE OR GATE,SCRN	02735	CD4070BFX
U146	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U148	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U151	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U151	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U151	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U151	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U152	156-0041-05	B020000	B019999	MICROCKT,DGTL:DUAL D FLIP FLOP SCRN	01295	SN7474NP3
U152	156-0331-03	B020000		MICROCKT,DGTL:DUAL D TYPE POSITIVE EDGE	01295	SN74S74NP3
U159	156-0112-00			MICROCKT,DGTL:QUAD 2-INP NAND GATE	01295	SN7426N
U160	156-0651-02			MICROCKT,DGTL:8-BIT PRL-OUT SER SHF RGTR	01295	SN74LS164NP3
U161	156-0651-02			MICROCKT,DGTL:8-BIT PRL-OUT SER SHF RGTR	01295	SN74LS164NP3
U162	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U163	156-0043-03	B010100	B019999	MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U163	156-0030-00	B020000		MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U164	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U165	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U166	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U167	156-0043-03	B010100	B019999	MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U167	156-0382-02	B020220		MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN (SPG1 ONLY)	18324	N74LS00NB
U167	156-0382-02	B021322		MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN (SPG2 ONLY)	18324	N74LS00NB
U195	156-0784-02	B030000		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR	01295	SN74LS163AN P3
U196	156-0467-02	B030000		MICROCKT,DGTL:QUAD 2-INP NAND BFR W/OC OUT	01295	SN74LS38NP3
U197	156-0784-02	B030000		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR	01295	SN74LS163AN P3
U198	156-0733-02	B030000		MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U200	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U205	156-0411-00			MICROCKT,LINEAR:SGL SPLY COMPARATOR	04713	LM339N
U220	156-0487-02			MICROCKT,DGTL:DUAL RETRIGGERABLE MONO MV	07263	96L02PCQR
U224	156-0043-03			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U229	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U240	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U244	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U245	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U249	156-0388-03	B010100	B010139	MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				(SPG1 ONLY)		
U249	156-0041-05	B010140		MICROCKT,DGTL:DUAL D FLIP FLOP SCRN (SPG1 ONLY)	01295	SN7474NP3
U249	156-0388-03	B010100	B010559	MICROCKT,DGTL:DUAL D FLIP-FLOP (SPG2 ONLY)	01295	SN74LS74ANP3
U249	156-0041-05	B010560		MICROCKT,DGTL:DUAL D FLIP FLOP SCRN (SPG2 ONLY)	01295	SN7474NP3
U254	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
U255	156-0043-03			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U259	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U259	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U259	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U259	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U275	156-0186-02	B010100	B010136	MICROCKT,DGTL:QUAD 2-INP NAND GATE, (SPG1 ONLY)	18324	N7403(NB OR FB)
U275	156-0144-00	B010137		MICROCKT,DGTL:3-INPUT NAND GATE (SPG1 ONLY)	01295	SN7412 N OR J
U275	156-0186-02	B010100	B010559	MICROCKT,DGTL:QUAD 2-INP NAND GATE, (SPG2 ONLY)	18324	N7403(NB OR FB)
U275	156-0144-00	B010560		MICROCKT,DGTL:3-INPUT NAND GATE (SPG2 ONLY)	01295	SN7412 N OR J
U279	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U279	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U279	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U279	156-0784-02	B021842		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U284	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
U285	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U289	156-0784-00	B010100	B020291	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG1 ONLY)	01295	SN74LS163AN
U289	156-0784-02	B020292		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG1 ONLY)	01295	SN74LS163AN P3
U289	156-0784-00	B010100	B021841	MICROCKT,DGTL:SYN 4-BIT BINARY COUNTER (SPG2 ONLY)	01295	SN74LS163AN
U289	156-0784-02	B028142		MICROCKT,DGTL:SYNCHRONOUS 4-BIT BINARY CNTR (SPG2 ONLY)	01295	SN74LS163AN P3
U299	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U309	156-0385-02			MICROCKT,DGTL:HEX INVERTER	07263	74LS04PCQR
U325	156-0487-02			MICROCKT,DGTL:DUAL RETRIGGERABLE MONO MV	07263	96L02PCQR
U329	156-0251-00			MICROCKT,DGTL:HIGH SPEED COMPTR	27014	LM361H
U330	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U334	156-0406-00			MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR	27014	DM8090 N OR J
U385	156-0112-00			MICROCKT,DGTL:QUAD 2-INP NAND GATE	01295	SN7426N
U386	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U388	156-0406-00			MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR	27014	DM8090 N OR J
U389	156-0129-02			MICROCKT,DGTL:QUAD 2-INP & GATE	18324	N7408(NB OR FB)
U396	156-0043-03			MICROCKT,DGTL:QUAD 2-INP NOR GATE,SCRN	18324	N7402(NB OR FB)
U398	156-0034-02			MICROCKT,DGTL:DUAL 4 INP NAND GATE,SCRN	18324	N7420(NB OR FB)
U399	156-0406-00			MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR	27014	DM8090 N OR J
U400	156-0487-02			MICROCKT,DGTL:DUAL RETRIGGERABLE MONO MV	07263	96L02PCQR
U401	156-0651-02			MICROCKT,DGTL:8-BIT PRL-OUT SER SHF RGTR	01295	SN74LS164NP3
U406	156-0406-00			MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR	27014	DM8090 N OR J
U410	156-0129-02			MICROCKT,DGTL:QUAD 2-INP & GATE	18324	N7408(NB OR FB)
U420	156-0030-00			MICROCKT,DGTL:QUAD 2-INPUT NAND GATE	01295	SN7400(N OR J)
U426	156-0405-03			MICROCKT,DGTL:DUAL RETRIG MONOSTABLE MV	18324	N9602(NB OR FB)

Component No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Name & Description	Mfr. Code	Mfr. Part No.
U489	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL (SPG2 ONLY)	04713	MC1458P1/MC1458U
U510	156-0495-00			MICROCKT,LINEAR:OPNL AMPL (SPG2 ONLY)	01295	LM324N
U619	156-0067-00			MICROCKT,LINEAR:OPNL AMPL,SEL (SPG2 ONLY)	04713	MC1741CP1
U626	156-0130-00	B010100	B021841	MICROCKT,LINEAR:MODULATOR/DEMODULATOR (SPG2 ONLY)	80009	156-0130-00
U626	156-0130-02	B021842		MICROCKT,LINEAR:MODULATOR/DEMODULATOR,SCRN (SPG2 ONLY)	04713	SC77162GH
U630	156-0130-00	B010100	B021841	MICROCKT,LINEAR:MODULATOR/DEMODULATOR (SPG2 ONLY)	80009	156-0130-00
U630	156-0130-02	B021842		MICROCKT,LINEAR:MODULATOR/DEMODULATOR,SCRN (SPG2 ONLY)	04713	SC77162GH
U639	156-0130-00	B010100	B021841	MICROCKT,LINEAR:MODULATOR/DEMODULATOR (SPG2 ONLY)	80009	156-0130-00
U639	156-0130-02	B021842		MICROCKT,LINEAR:MODULATOR/DEMODULATOR,SCRN (SPG2 ONLY)	04713	SC77162GH
U700	155-0144-00			MICROCKT,LINEAR:SYN STRIPPER (SPG2 ONLY)	80009	155-0144-00
U790	156-0385-02			MICROCKT,DGTL:HEX INVERTER	07263	74LS04PCQR
U798	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U808	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U810	156-0733-02			MICROCKT,DGTL:DUAL MONOSTABLE MV W/ST INP	01295	SN74LS221N3
U815	156-0158-00			MICROCKT,LINEAR:DUAL OPNL AMPL	04713	MC1458P1/MC1458U
U818	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U825	156-0388-03			MICROCKT,DGTL:DUAL D FLIP-FLOP	01295	SN74LS74ANP3
U828	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U835	156-0381-02			MICROCKT,DGTL:QUAD 2-INP EXCL OR GATE	07263	74LS86PCQR
U838	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U848	155-0145-00			MICROCKT,LINEAR:PULSE OUTPUT AMPL	80009	155-0145-00
U851	156-0383-02			MICROCKT,DGTL:QUAD 2-INP NOR GATE	18324	N74LS02NB
U853	156-0406-00	B010100	B020210	MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR (SPG1 ONLY)	27014	DM8090 N OR J
U853	156-0383-02	B020211		MICROCKT,DGTL:QUAD 2-INP NOR GATE (SPG1 ONLY)	18324	N74LS02NB
U853	156-0406-00	B010100	B021236	MICROCKT,DGTL:QUAD INV/DUAL 2-INP NAND BFR (SPG2 ONLY)	27014	DM8090 N OR J
U853	156-0383-02	B021237		MICROCKT,DGTL:QUAD 2-INP NOR GATE (SPG2 ONLY)	18324	N74LS02NB
U854	156-0382-02	B020211		MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN (SPG1 ONLY)	18324	N74LS00NB
U854	156-0382-02	B021237		MICROCKT,DGTL:QUAD 2 INP NAND GATE BURN (SPG2 ONLY)	18324	N74LS00NB
U855	156-0386-02			MICROCKT,DGTL:TRIPLE 3-INP NAND GATE	07263	74LS10PCQR
U859	156-0422-02			MICROCKT,DGTL:UP/DOWN SYN BINARY CNTR	18324	N74LS191NB
U918	156-0130-00	B010100	B020291	MICROCKT,LINEAR:MODULATOR/DEMODULATOR (SPG1 ONLY)	80009	156-0130-00
U918	156-0130-02	B020292		MICROCKT,LINEAR:MODULATOR/DEMODULATOR,SCRN (SPG1 ONLY)	04713	SC77162GH
U918	156-0130-00	B010100	B021841	MICROCKT,LINEAR:MODULATOR/DEMODULATOR (SPG2 ONLY)	80009	156-0130-00
U918	156-0130-02	B021842		MICROCKT,LINEAR:MODULATOR/DEMODULATOR,SCRN (SPG2 ONLY)	04713	SC77162GH
U921	156-0785-05			MICROCKT,DGTL:PROM,PROGRAMMED	80009	156-0785-05
VR129	152-0278-00	B010200	B019999	SEMICOND DVC,DI:ZEN,SI,3V,5%,0.4W,DO-7	04713	SZG35009K20
VR150	152-0226-00	B020000		SEMICOND DVC,DI:ZEN,SI,5.1V,5%,0.4W,DO-7	04713	SZ12262RL
VR559	152-0127-00			SEMICOND DVC,DI:ZEN,SI,7.5V,5%,0.4W,DO-7	14433	Z5347 (1N9588)
VR650	152-0127-00			SEMICOND DVC,DI:ZEN,SI,7.5V,5%,0.4W,DO-7	14433	Z5347 (1N9588)
VR686	152-0395-00			SEMICOND DVC,DI:ZEN,SI,4.3V,5%,0.4W	04713	SZG35009K18
VR906	152-0226-00			SEMICOND DVC,DI:ZEN,SI,5.1V,5%,0.4W,DO-7	04713	SZ12262RL
W794	131-0566-00			BUS,COND:DUMMY RES,0.094 OD X 0.225L	24546	OMA 07

SERVICING ILLUSTRATIONS

Information contained in this section serves as an aid to the service technician who performs the calibration, maintenance, and troubleshooting procedures. Included are illustrations showing the adjustment and jumper locations for each circuit board, and troubleshooting charts.

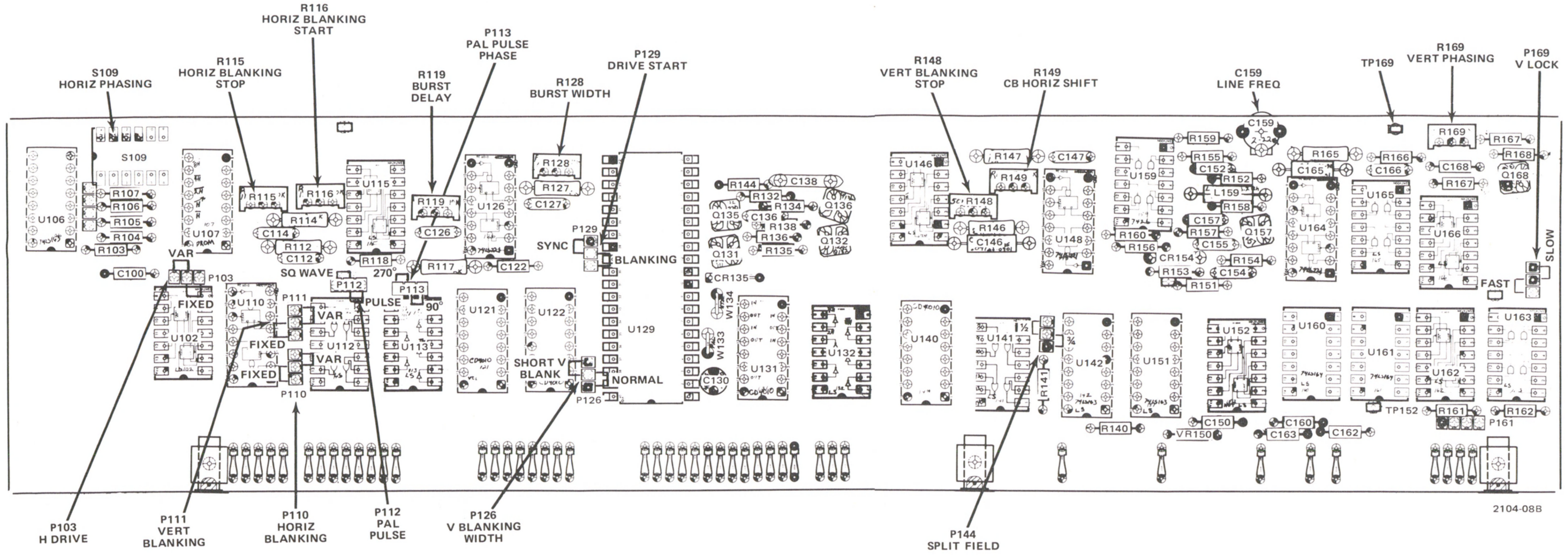


FIG. 8-1A. A20 SYNC TIMING BOARD ADJUSTMENT LOCATIONS & JUMPERS (SN B020000 &UP).

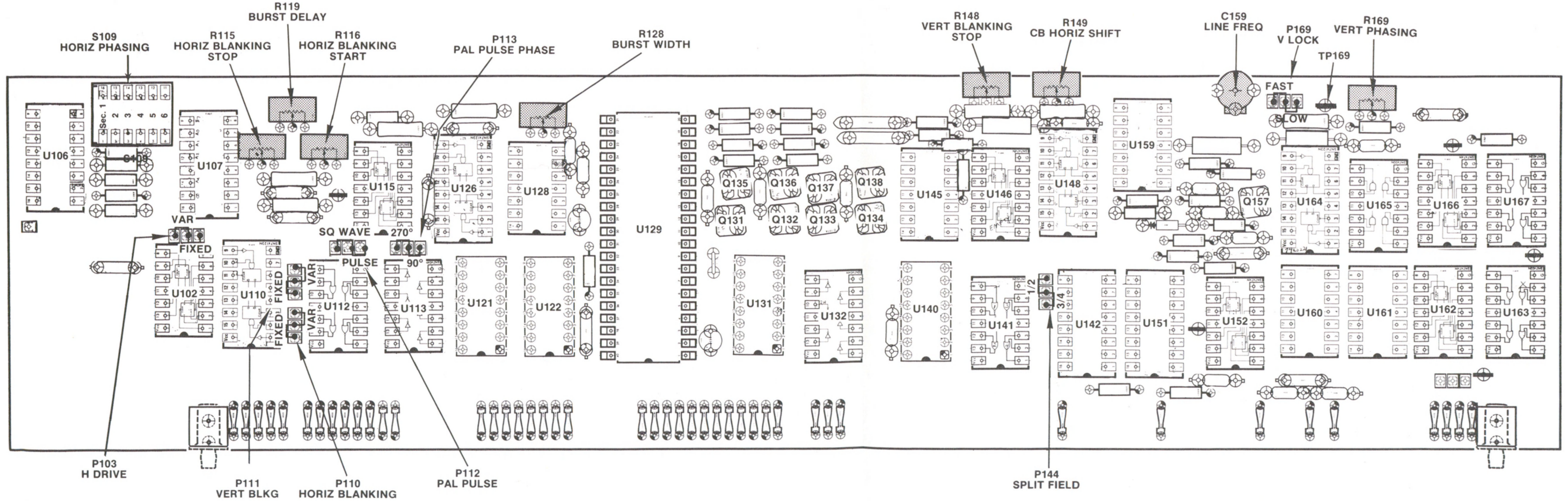


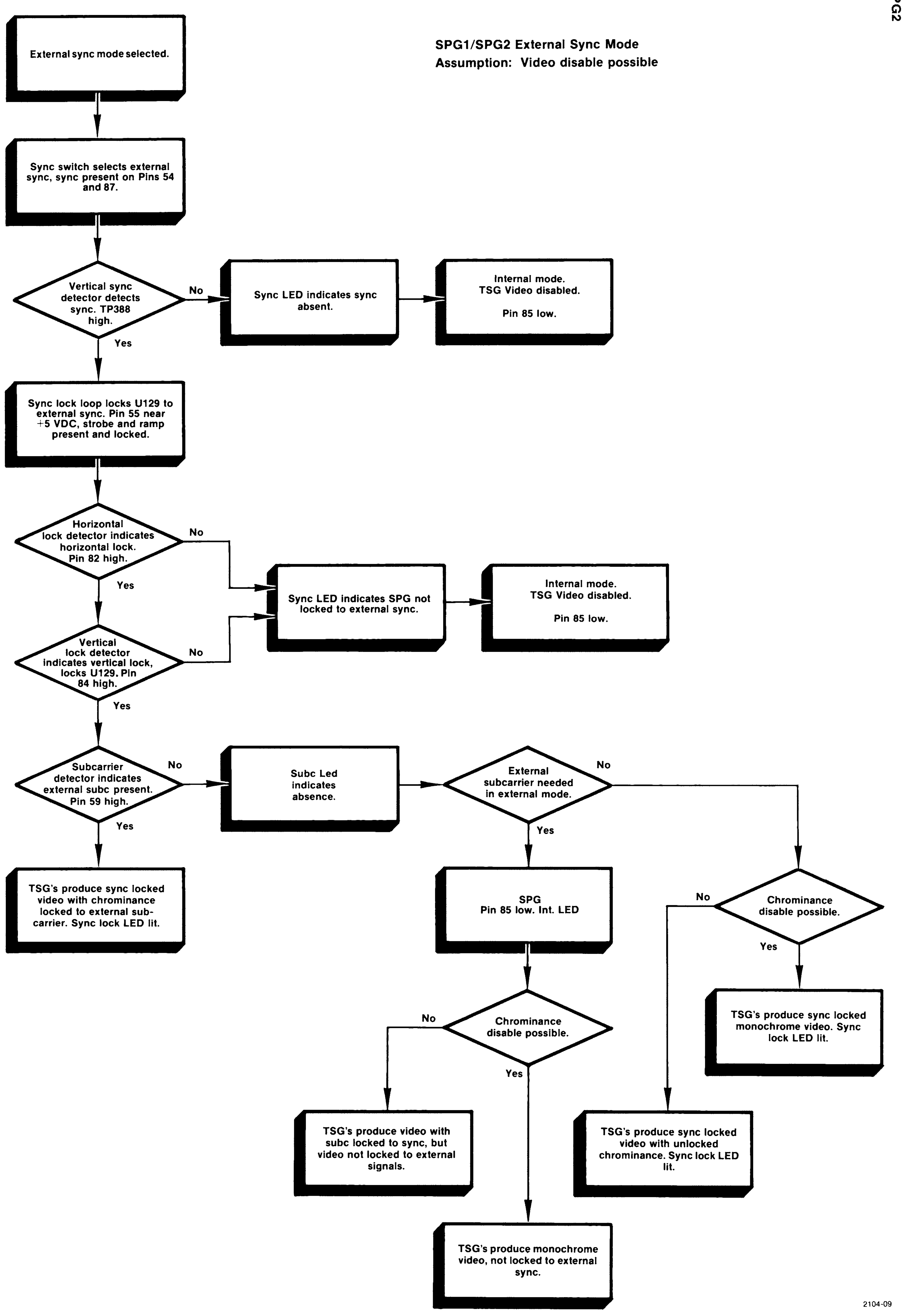
FIG. 8-1B. A20 SYNC TIMING BOARD ADJUSTMENT LOCATIONS & JUMPERS (SN B019999 & BELOW).

REV JUL 1983

2104-49

FIG. 8-2. TROUBLESHOOTING CHART 1.

SPG1/SPG2 External Sync Mode
Assumption: Video disable possible



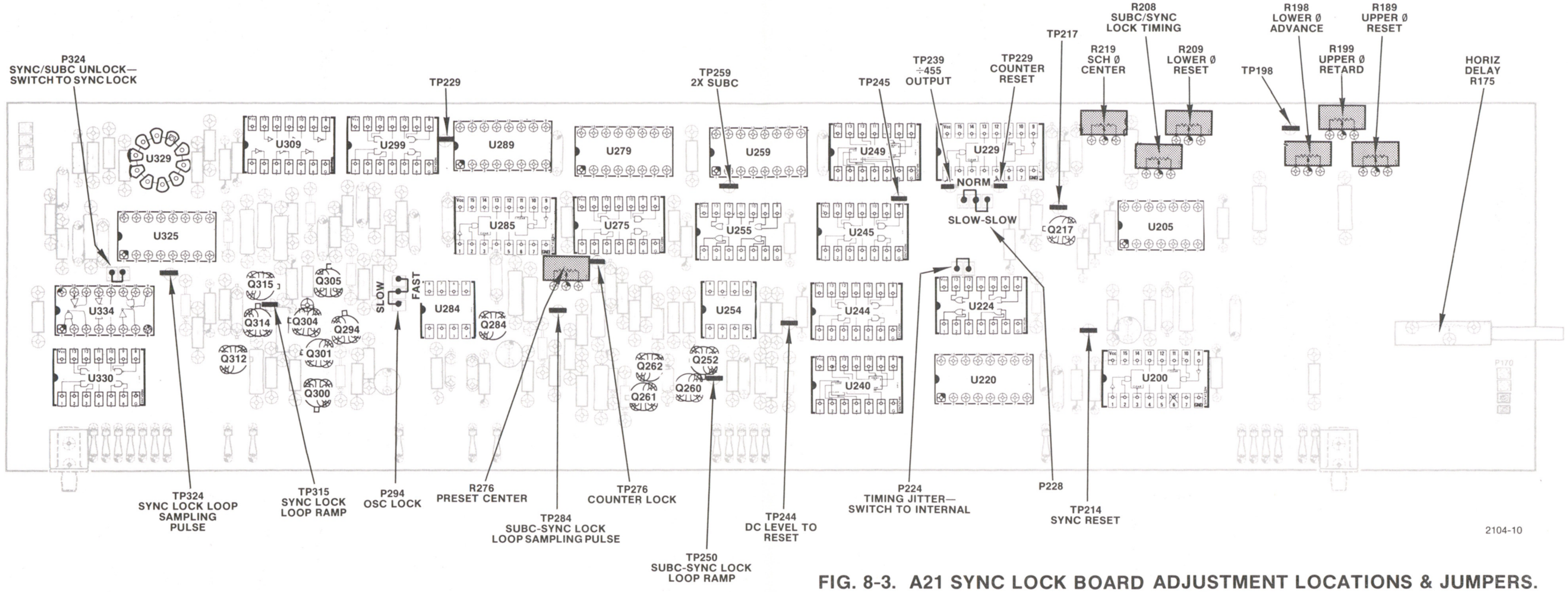
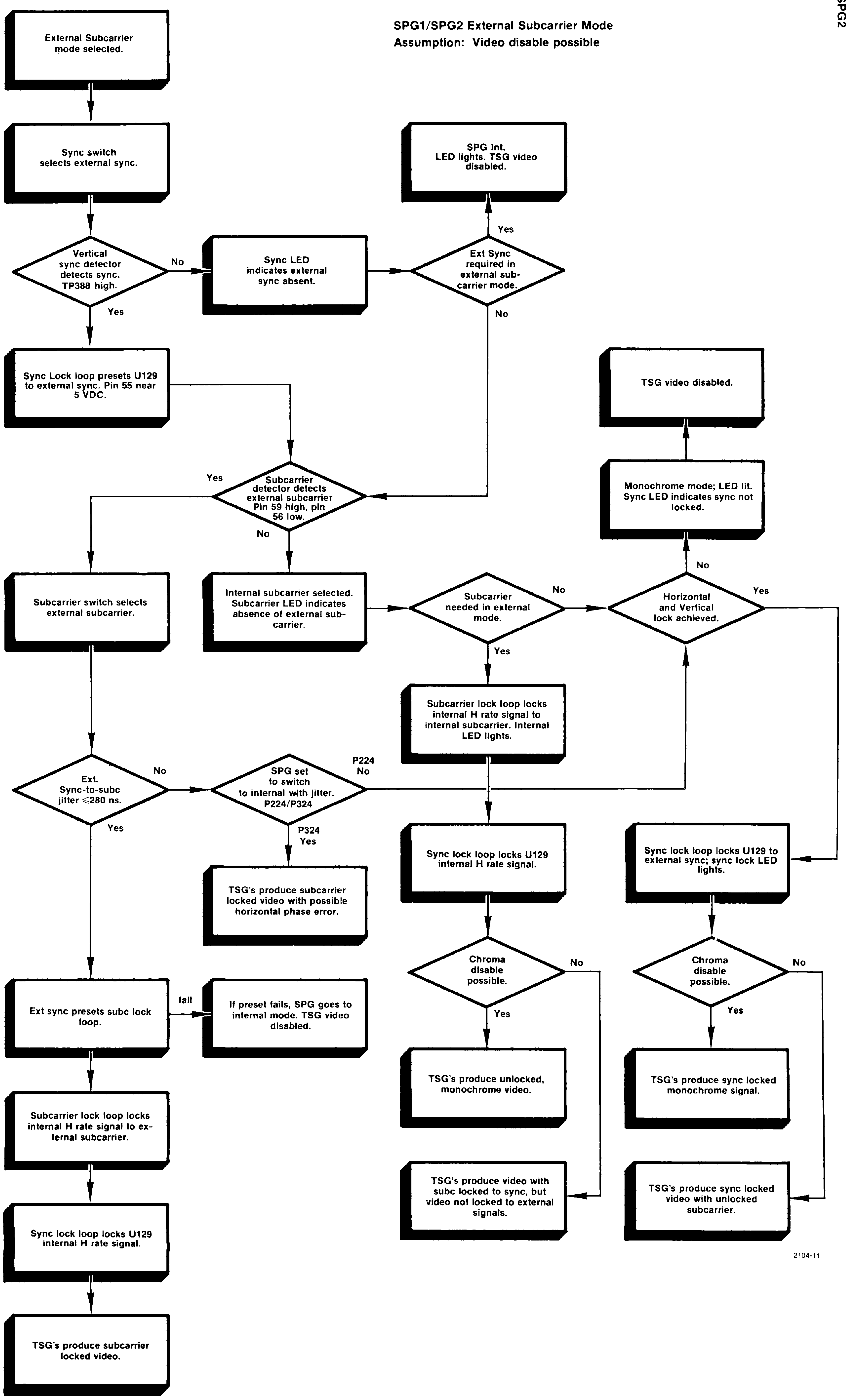


FIG. 8-3. A21 SYNC LOCK BOARD ADJUSTMENT LOCATIONS & JUMPERS.

FIG. 8-4. TROUBLESHOOTING CHART 2.

SPG1/SPG2 External Subcarrier Mode
Assumption: Video disable possible



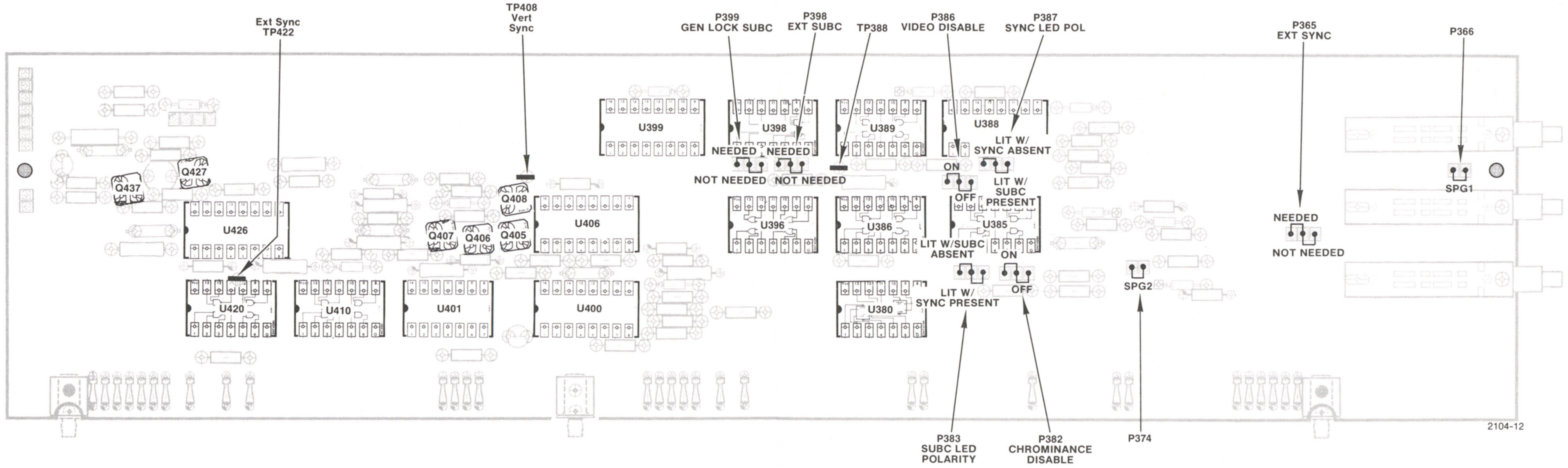
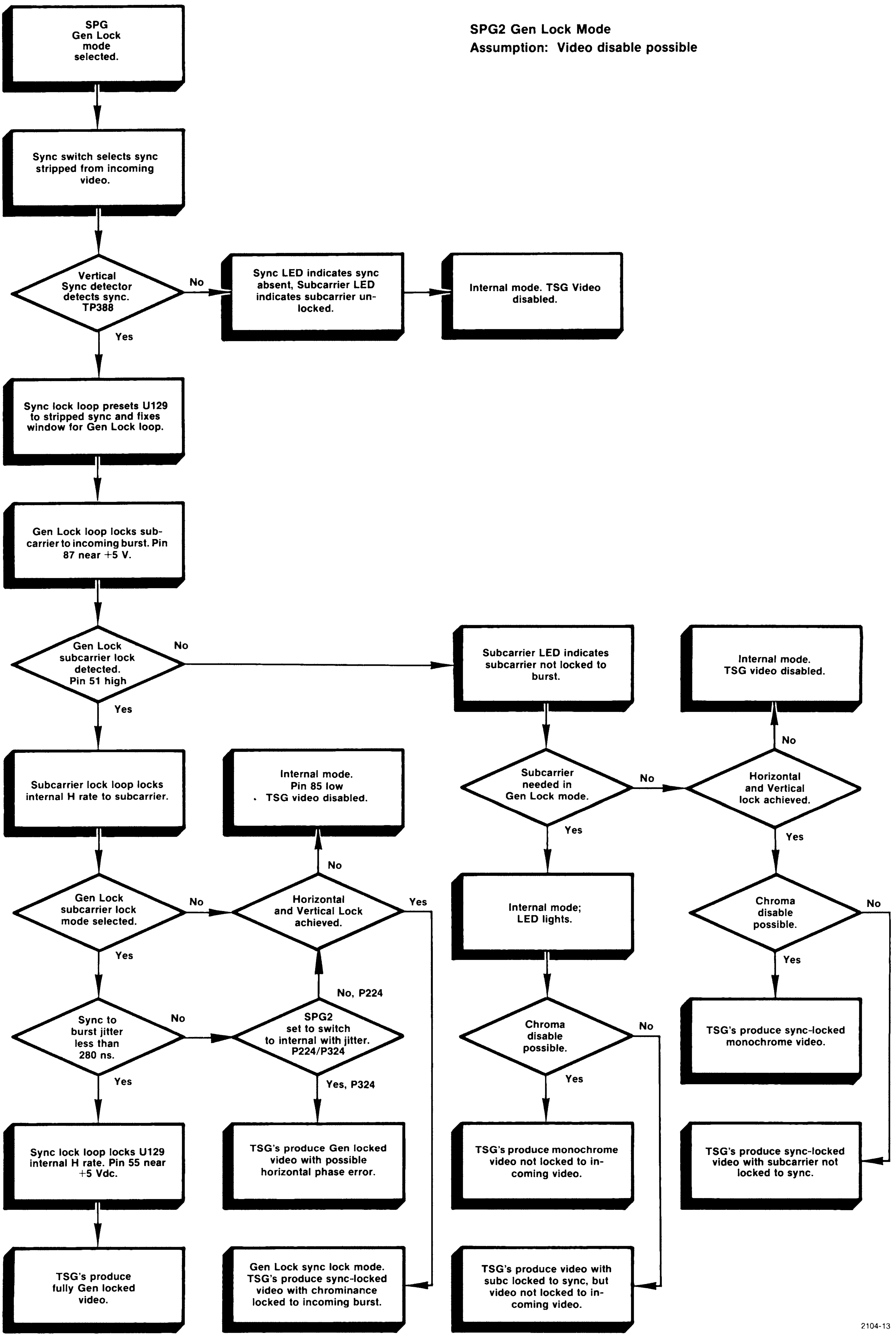


FIG. 8-5. A22 GENERATOR LOGIC BOARD JUMPERS LOCATIONS.

FIG. 8-6. TROUBLESHOOTING CHART 3.

SPG2 Gen Lock Mode
Assumption: Video disable possible



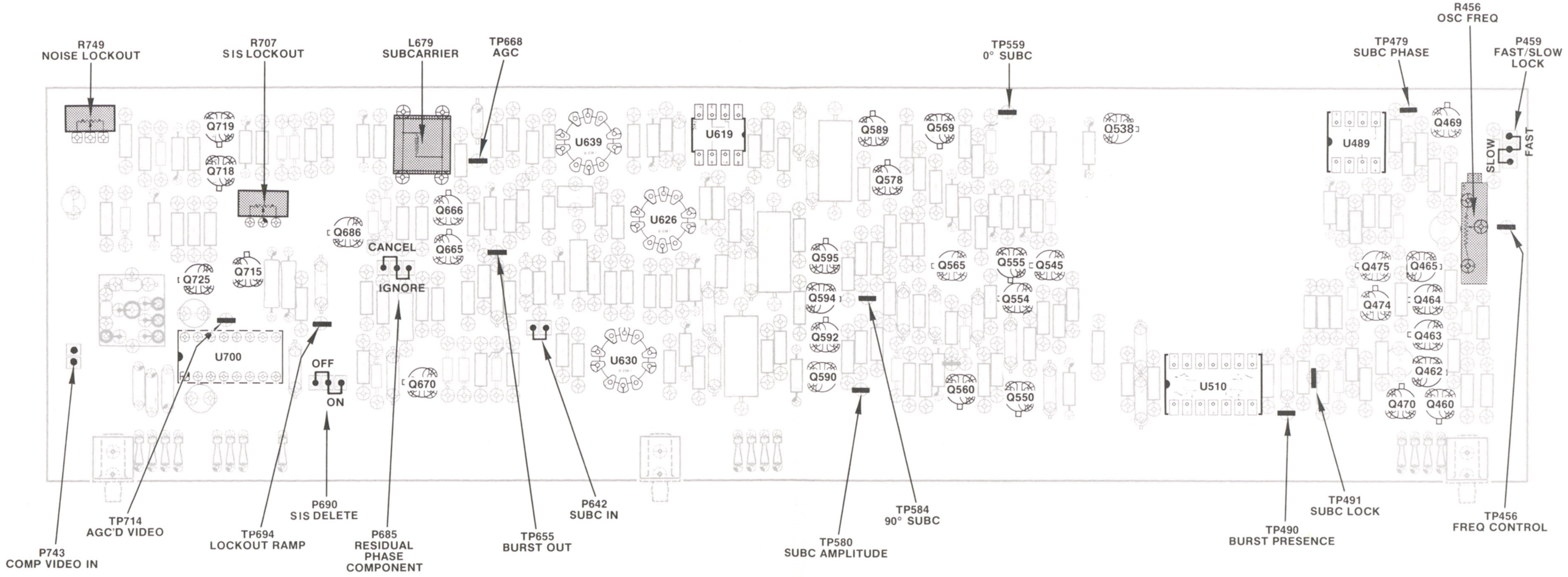


FIG. 8-7. A23 SUBCARRIER LOCK BOARD ADJUSTMENT LOCATIONS & JUMPERS.

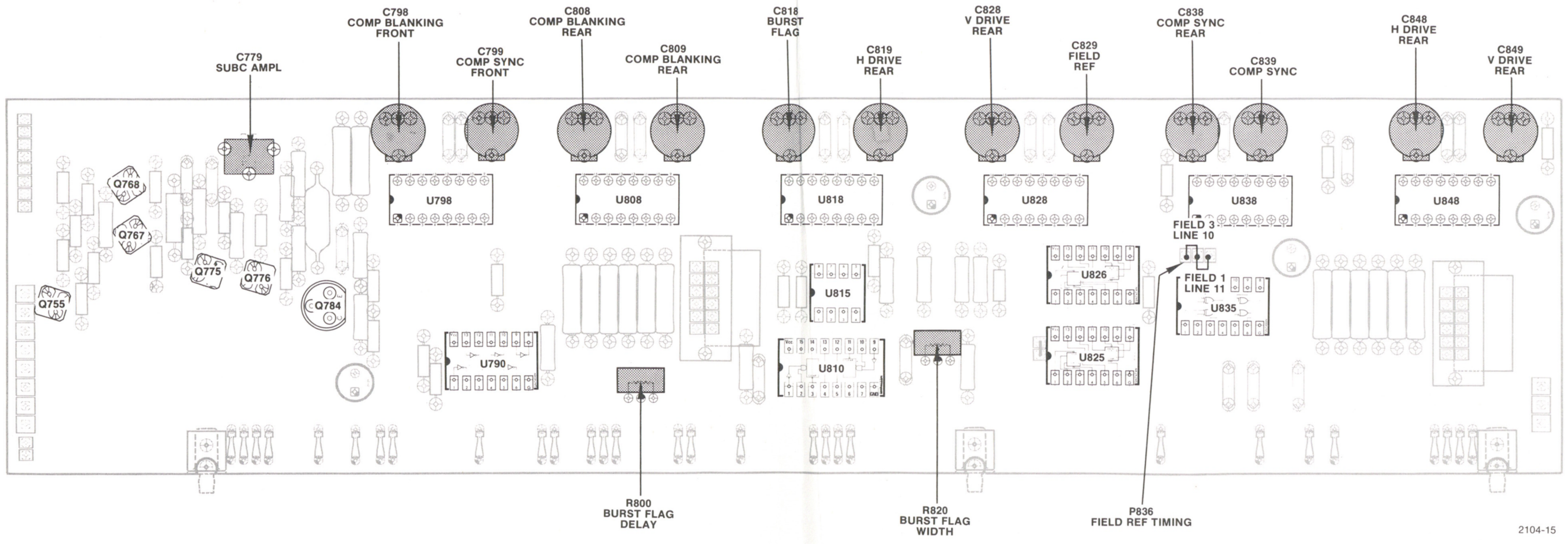
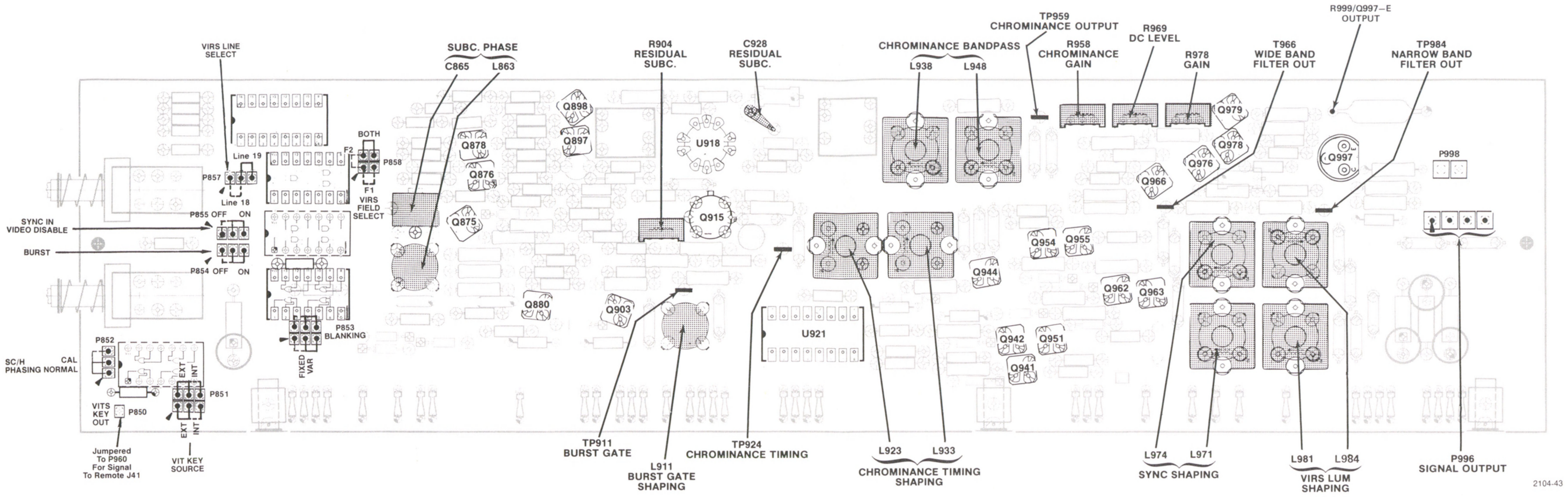
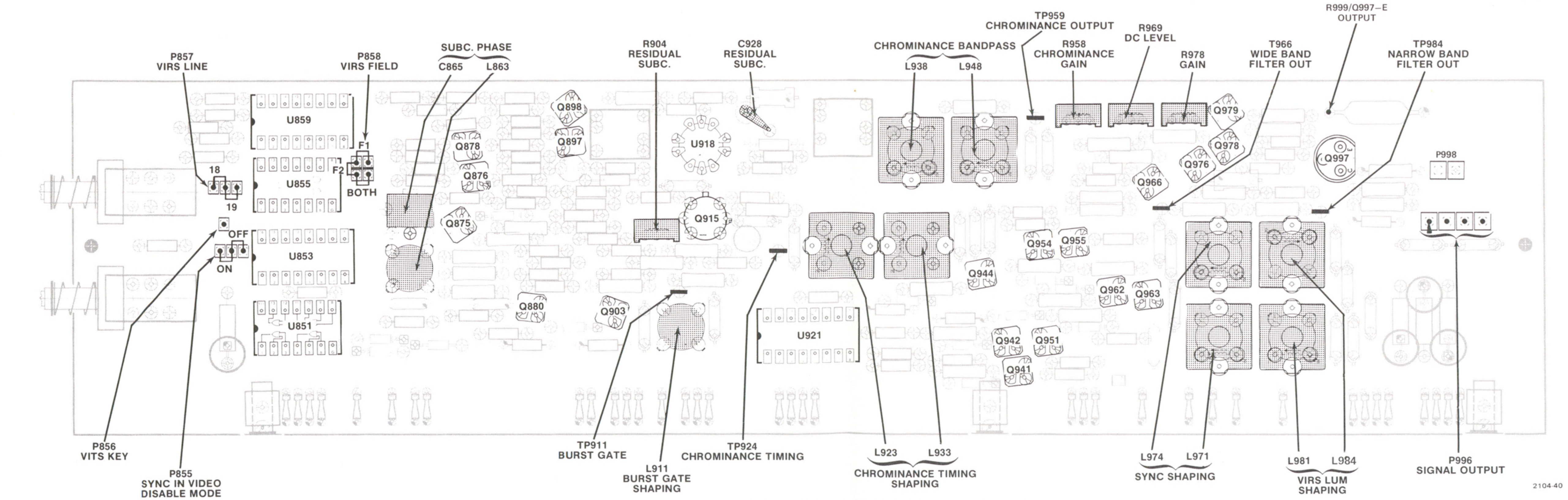


FIG. 8-8. A24 PULSE OUTPUT AMP BOARD ADJUSTMENT LOCATIONS & JUMPER.



SN B020211 & UP-SPG1 & SN B021237 & UP-SPG2



SN B010127 - SN B020210 SPG1

SN B010438 - SN B021236 SPG2

A25 (SN B010126 - BELOW) BACK OF PAGE

Fig. 8-9. A25 VIRS/BLACK BURST ADJUSTMENT LOCATIONS AND JUMPERS

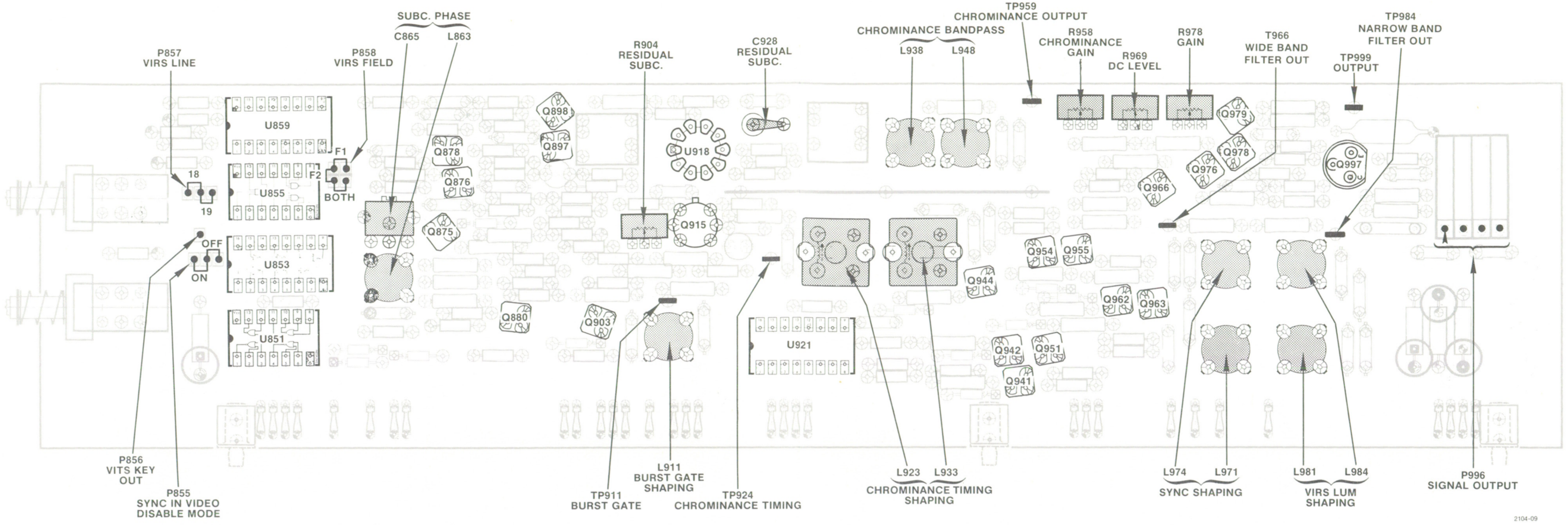
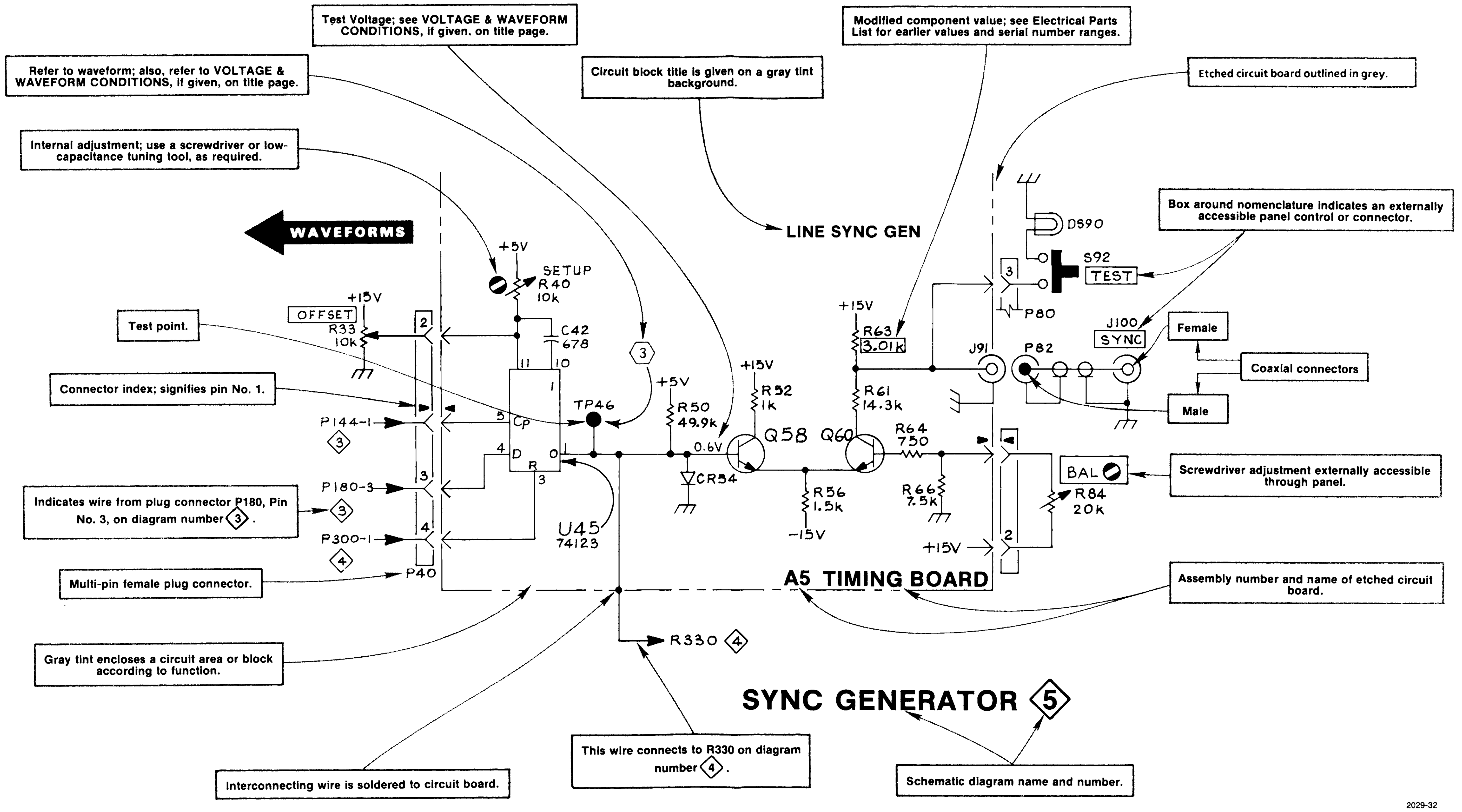


Fig. 8-10. A25 VIRS/BLACK BURST (SN B010126 & BELOW) SPG 1
(SN B010437 & BELOW) SPG 2



SCHEMATIC EXAMPLE

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

This section of the manual contains block and schematic diagrams with waveforms and etched circuit board illustrations.

Symbols

Symbols used on the diagrams are based on ANSI Y32.2-1970 and IEEE No. 315 March 1971. Logic symbology is based on ANSI Y32.14-1973 (IEEE Std. 91-1973). Logic symbols depict the logic function performed and may differ from the manufacturer's data.

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors	Values one or greater are in picofarads (pF). Values less than one are in micofarads (μF).
Resistors	Ohms (Ω).

Semiconductor Types

Refer to the Electrical Parts List.

Reference Designators

The following letters are used as reference designators to identify components or assemblies on Tektronix, Inc. schematic diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DH	Decoupling Hybrid
DL	Delay Line
DS	Indicating device (lamp)
E, SG	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor, silicon-controlled rectifier, or programmable unijunction transistor
R	Resistor, fixed or variable
RT	Thermistors
S	Switch
T	Transformer
TC	Thermocouple
TP	Test Point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

Partial Schematic Diagram With Explanations

The partial diagram at the left is an example of the various symbols and other information provided on Tektronix, Inc. diagrams.

Transformer Wiring

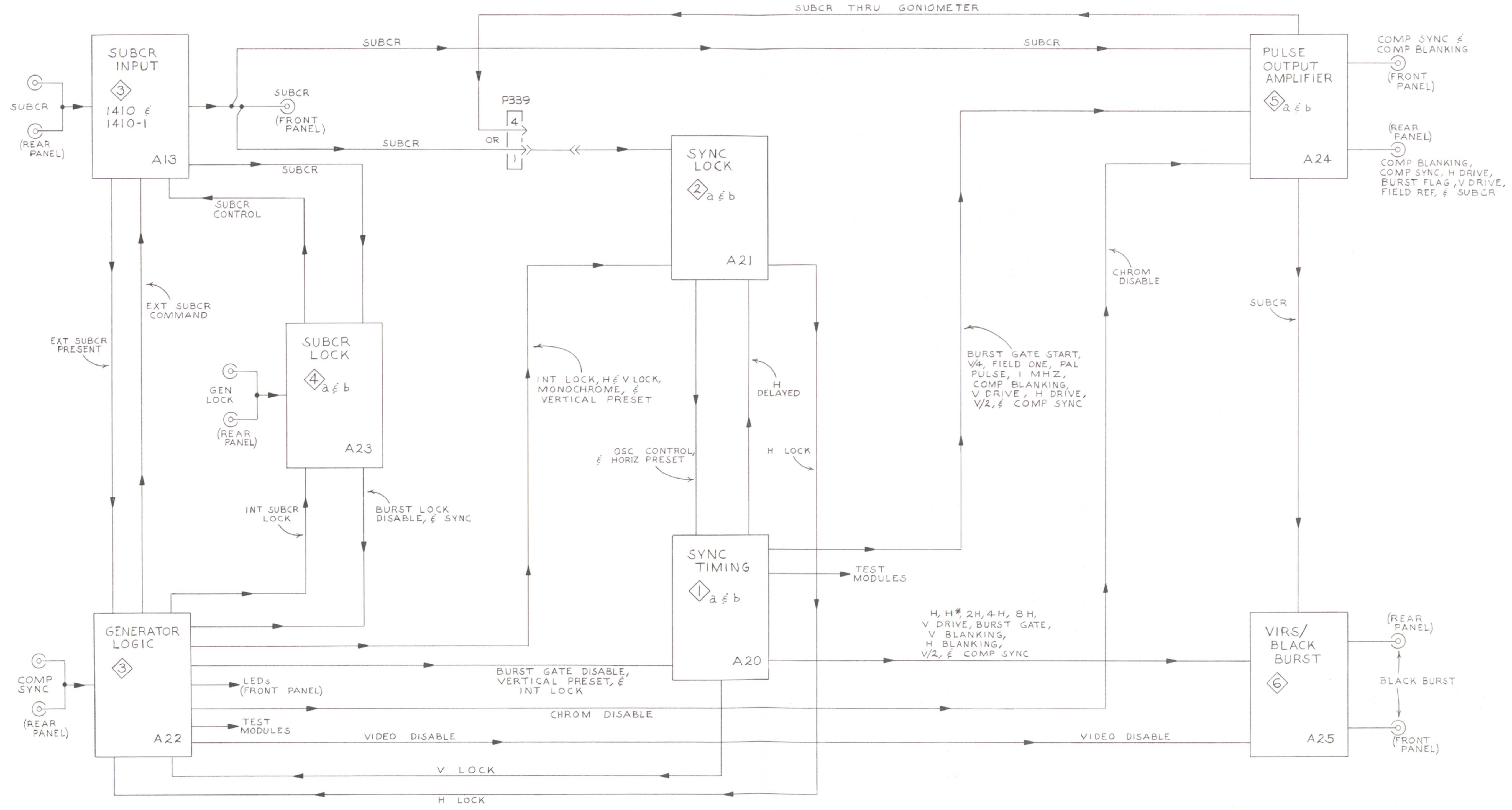
A two-letter abbreviation color code is used to identify wires without terminal connection labels.

Bk	Black
Br	Brown
Rd	Red
Or	Orange
Yl	Yellow
G	Green
Bl	Blue
Vi	Violet
Gy	Gray
W	White

WAVEFORM CONDITIONS

Waveform photographs in this section were taken with a TEKTRONIX C-59 Oscilloscope Camera mounted on a TEKTRONIX 7603 Oscilloscope with 7B53A Time Base and 7A13 Differential Comparator plug-ins.

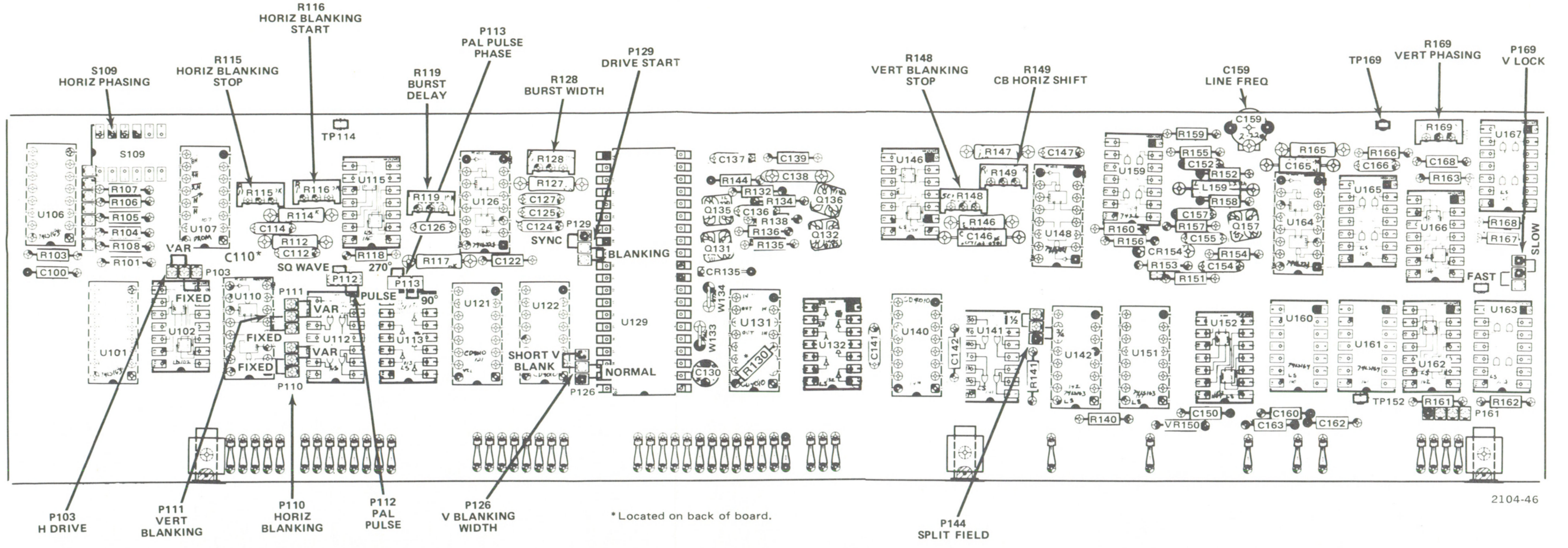
The vertical input was dc coupled except for those waveforms identified as ac coupled.



SPG 1 & 2

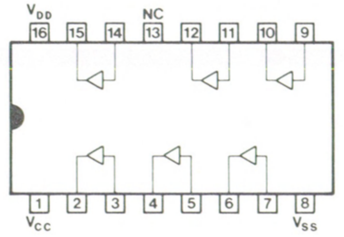
REV APR 1981 GEM 10/76

BLOCK DIAGRAM

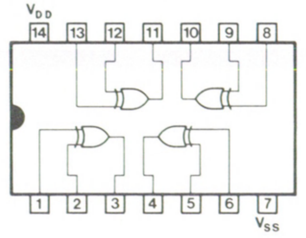


*See Parts List for serial number ranges.

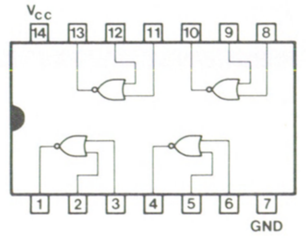
A20 SYNC TIMING CIRCUIT BOARD (SN B020000 & UP).



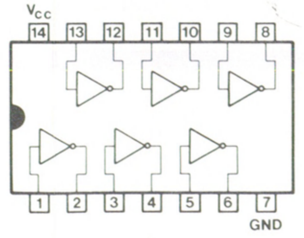
CD4010AE or HD1-4010-9



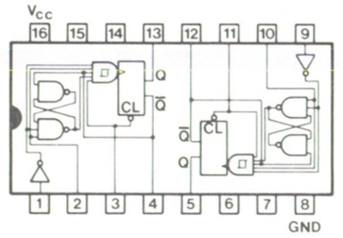
CD4070BF



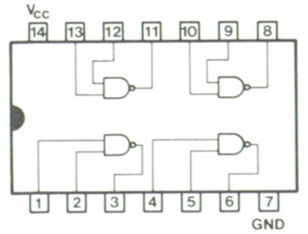
7402 or 74LS02

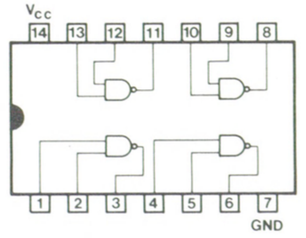


74LS04

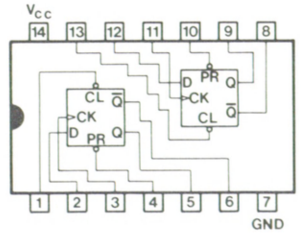


74LS221

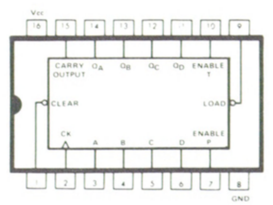




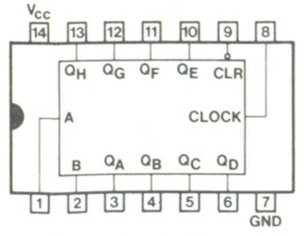
74LS26 or 7426



74LS74 or 7474

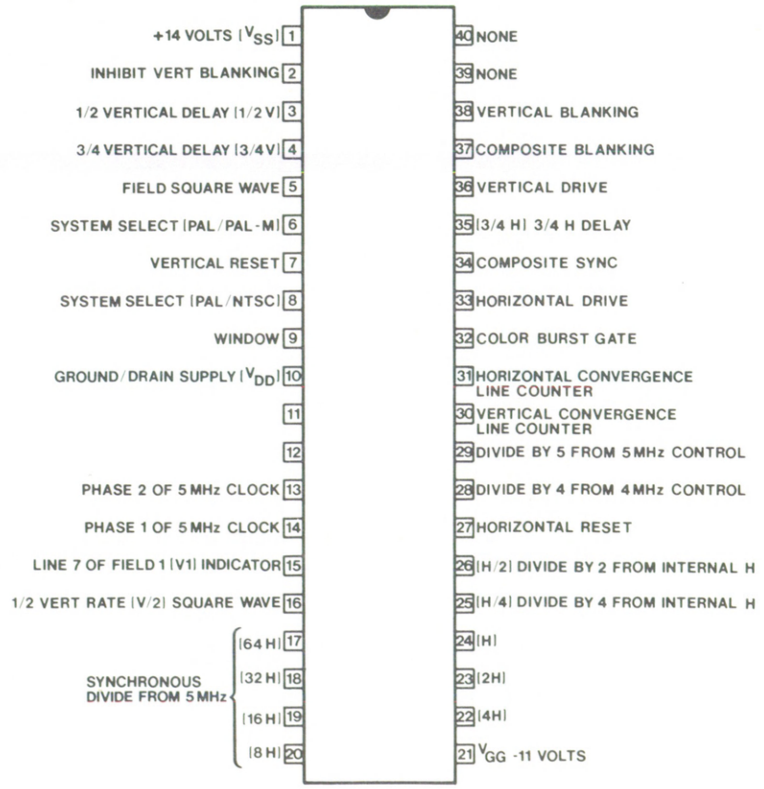


74LS163





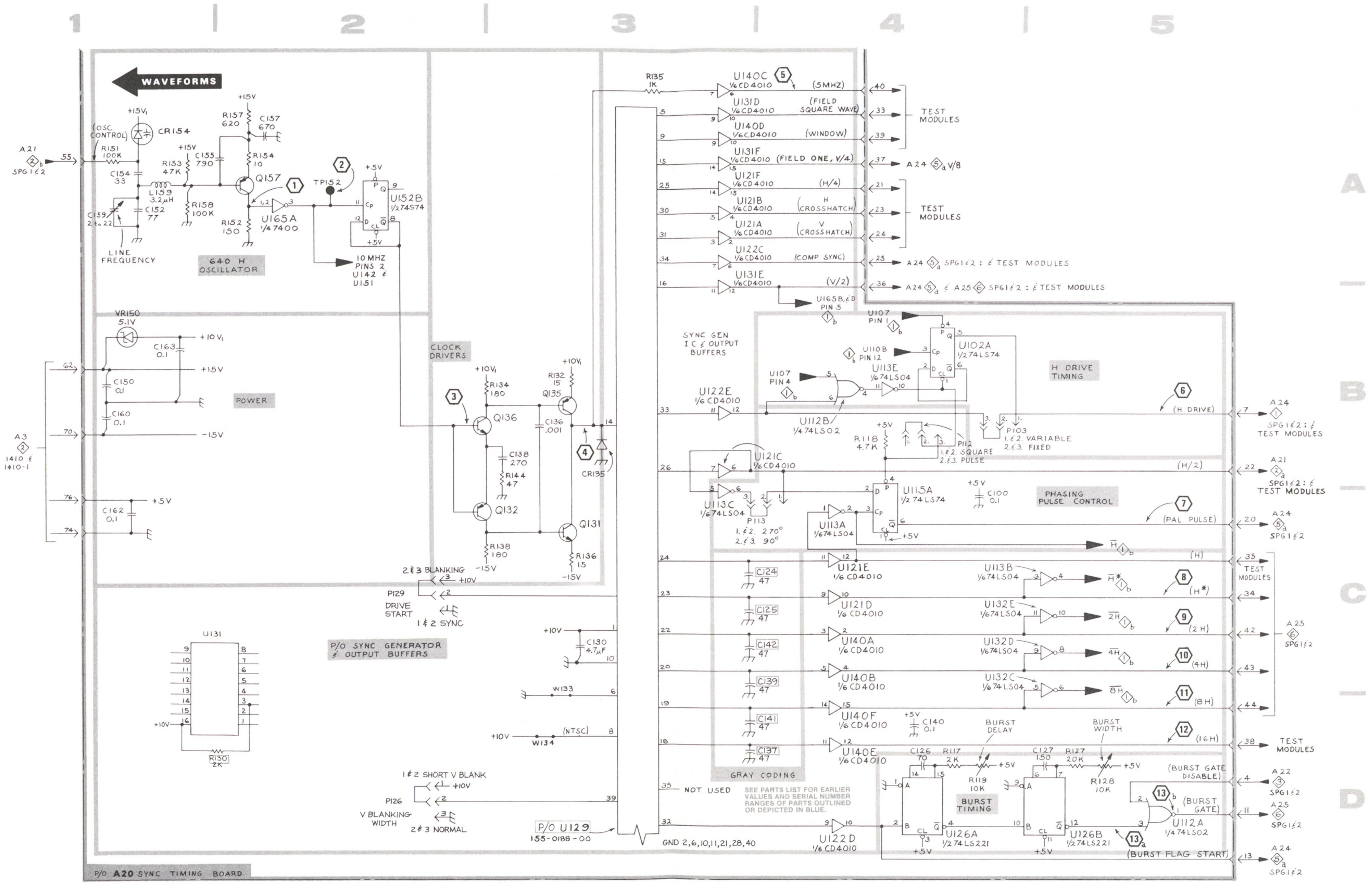
74288



155-0188-00

1a SYNC TIMING
PARTS LOCATING CHART

Part	Location
C100	C4
C123	C4
C124	C4
C125	C4
C126	D4
C127	D5
C128	B1
C129	B1
C130	C3
C135	B3
C136	B3
C137	D4
C138	B3
C139	C4
C140	D4
C141	D4
C142	C4
C143	C4
C144	D4
C145	D4
C150	B1
C152	A1
C154	A1
C155	A2
C157	A2
C159	A1
C160	B1
C162	C1
C163	B1
CR154	A1
L159	A1
P103	B4
P112	B4
P113	C4
Q131	C3
Q132	C3
Q133	B3
Q134	A3
Q135	B3
Q136	B3
Q137	A3
Q138	A3
Q157	A2
R117	D4
R118	B4
R119	D4
R124	D3
R127	D5
R128	D5
R132	B3
R133	A3
R134	B3
R135	A3
R136	C3
R137	B3
R138	C3
R139	B3
R141	A2
R142	C3
R143	D3
R144	B3
R145	A3
R150	B1
R151	A1
R152	A2
R153	A1
R154	A2
R156	A2
R157	A2
R158	A1
TP152	A2
U102A	B4
U112A	D5
U112B	B4
U113A	C4
U113B	C5
U113C	C3
U113E	B4
U115A	C4
U121A	A3
U121B	A3
U121C	B3
U121D	C4
U121E	C4
U121F	A3
U122C	A3
U122D	D4
U122E	B3
U126A	D4
U126B	D5
U128A	C4
U128B	C4
U129	D3
U131D	A3
U131E	A3
U131F	A3
U132C	C5
U132D	C5
U132E	C5
U140A	C4
U140B	C4
U140C	A3
U140D	A3
U140E	D4
U140F	D4
U145A	C4
U145B	D4
U145C	D4
U145D	D4
U152B	A2
U159D	A2
U165A	A2
VR129	B1
W133	D3
W134	D3



SPG 1 & 2

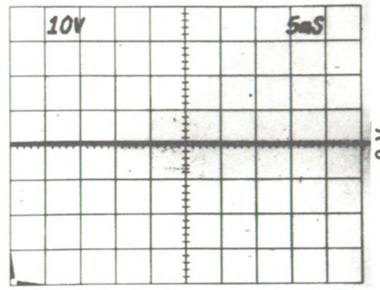
2104-23 REV JAN 1986

(SN B020000 & UP)

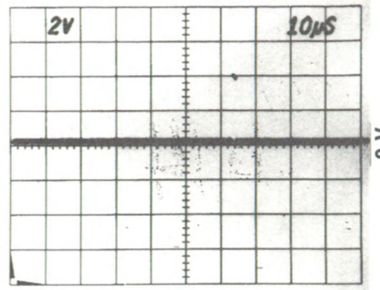
SYNC TIMING 1a

SPG1/SPG2

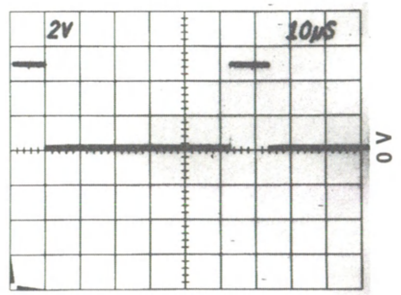
1b



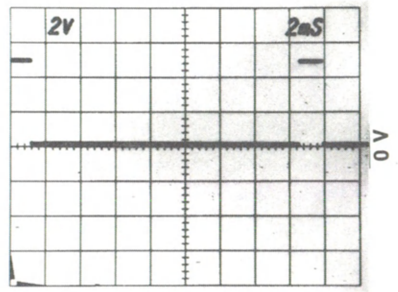
14



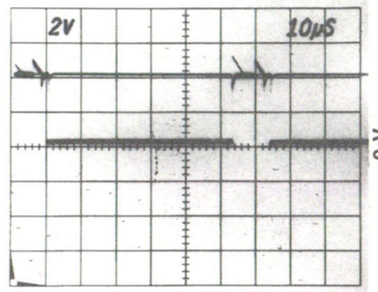
15



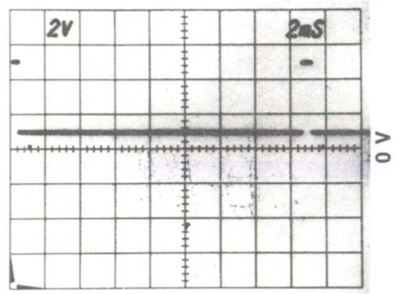
16a



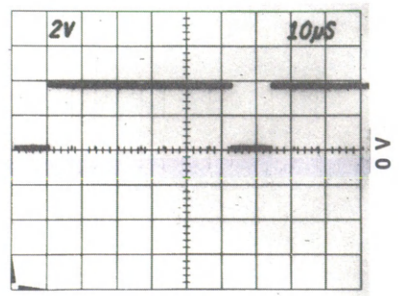
16b



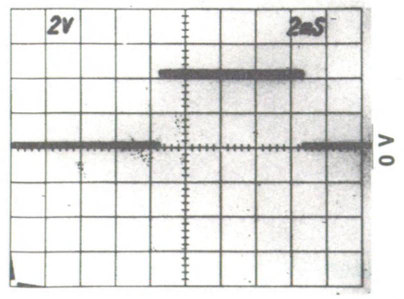
16c



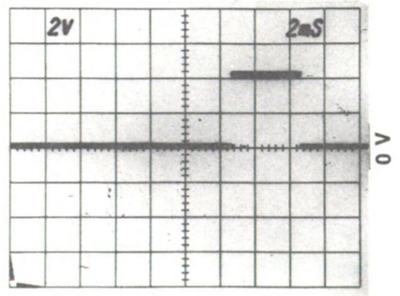
17



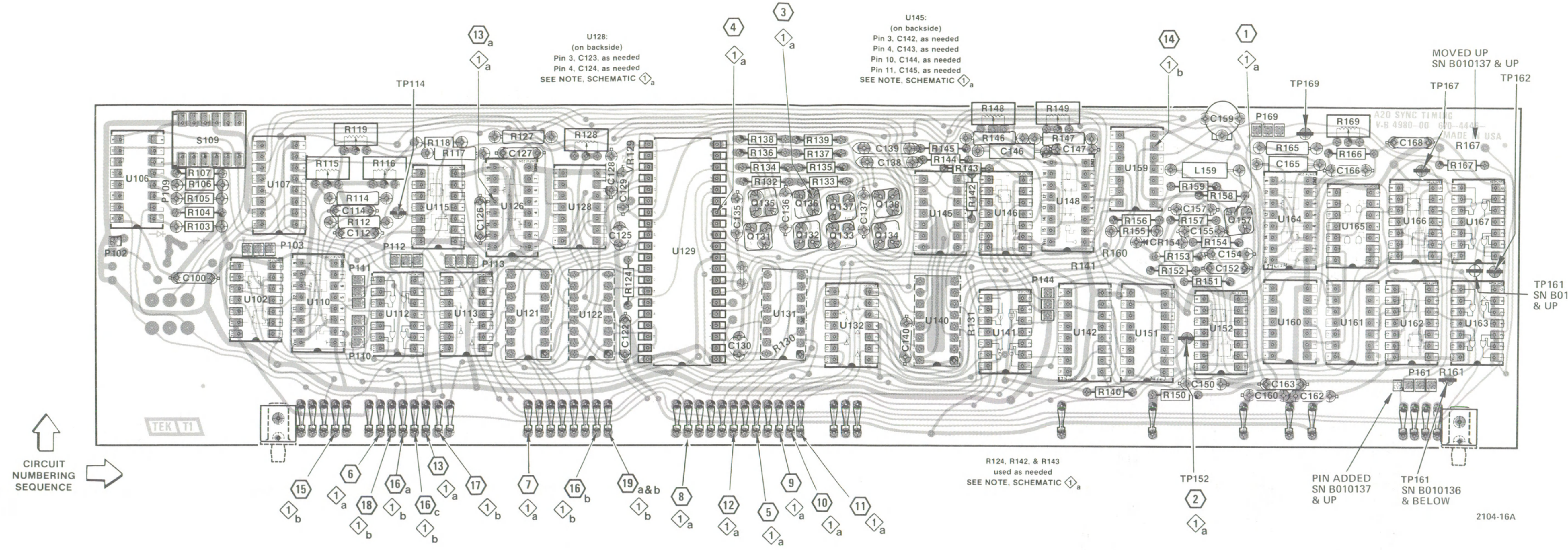
18



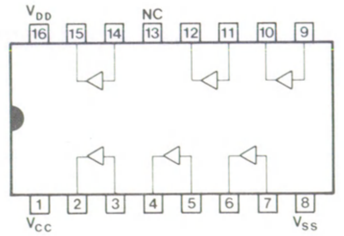
19a



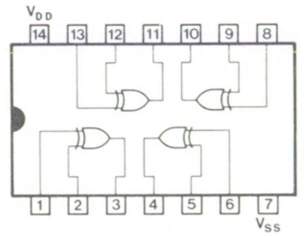
19b



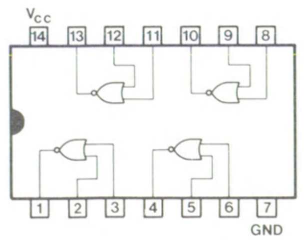
A20 SYNC TIMING CIRCIUT BOARD (SN B019999 & BELOW)



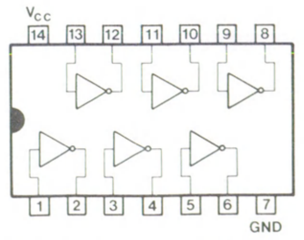
CD4010AE



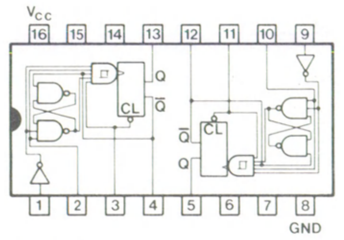
CD4070BE



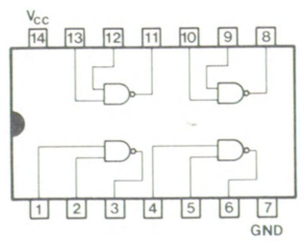
7402 or 74LS02



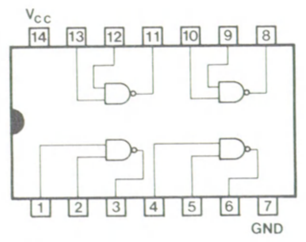
74LS04 or 7404



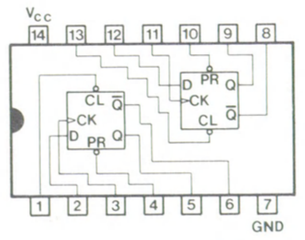
74LS221



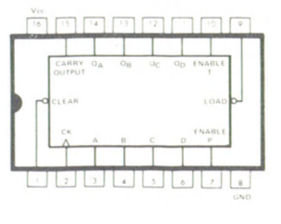
7400



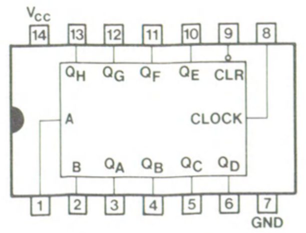
7426



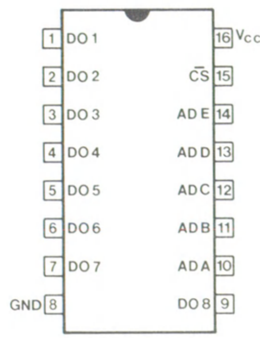
74LS74 or 7474



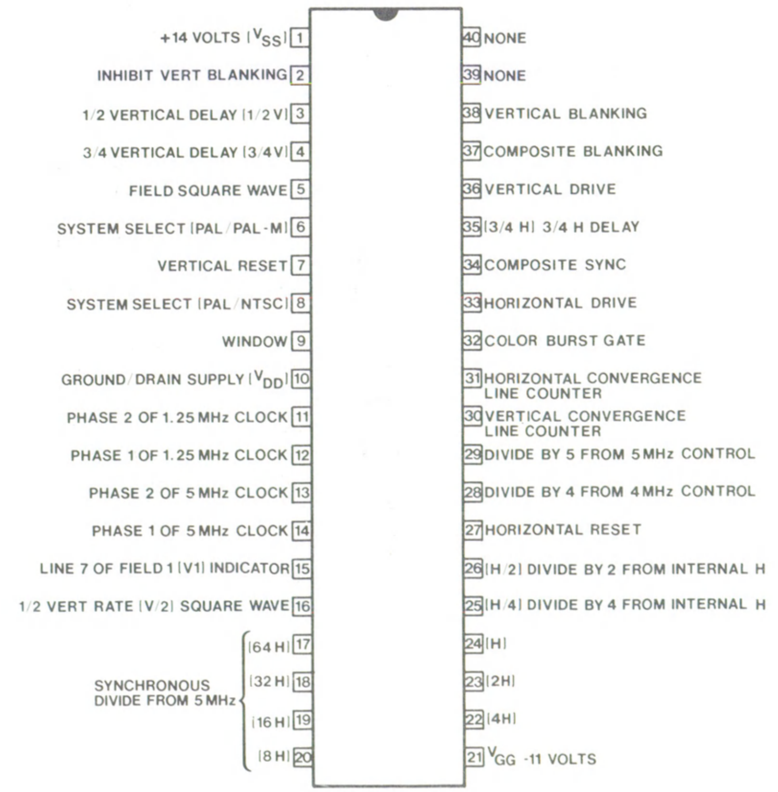
74163 or 74LS163



74164 or 74LS164

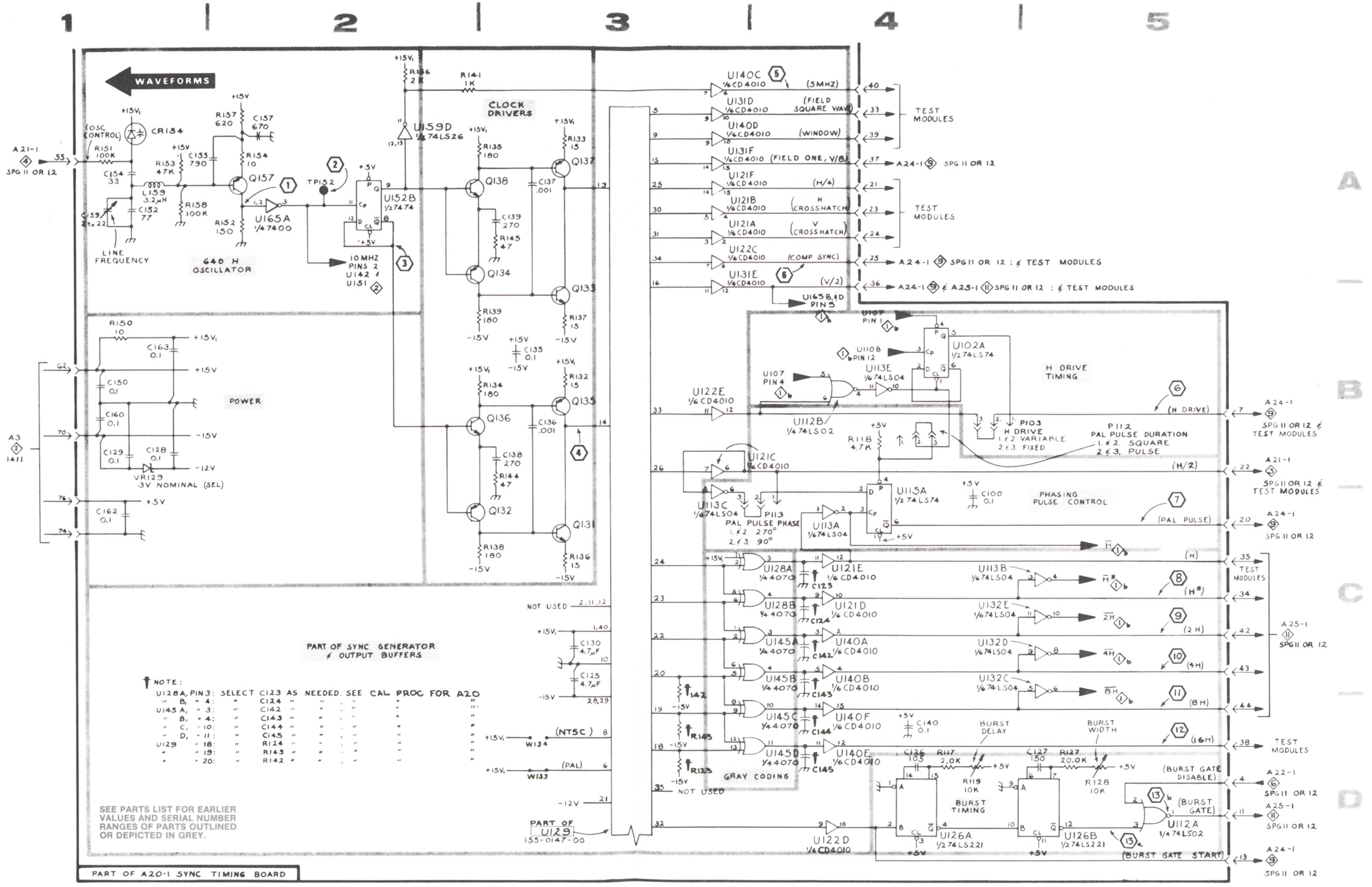


74288



155-0147-00

REV JUL 1983



SPG1 / SPG 2

2104-47
REV JAN 1986

SYNC TIMING
SN B019999 & BELOW

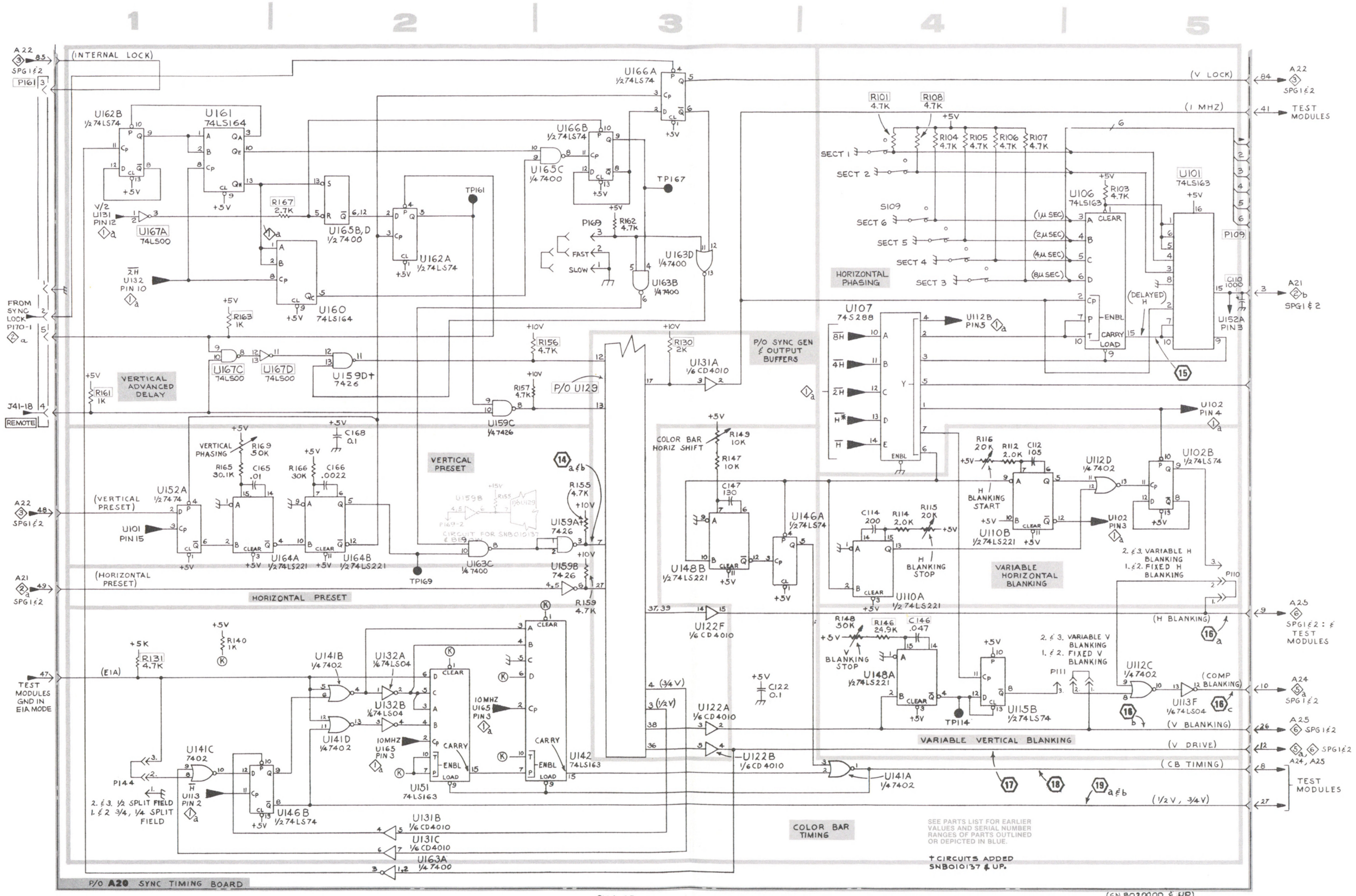
⟨1⟩b

SYNC TIMING
PARTS LOCATING CHART

C110*	B5
C112	B4
C114	C4
C122	D3
C124*	4A
C125*	4A
C137*	5A
C139*	5A
C141*	5A
C142*	5A
C146	C4
C147	C3
C165	C1
C166	C2
C168	B2
P109*	A5
P110	C5
P111	C5
P144	D1
P161	A2
P169	C2
R101*	A4
R103	A5
R104	A4
R105	A4
R106	A4
R107	A5
R108*	A4
R112	B4
R114	C4
R115	C4
R116	B4
R130*	B3
R131*	C1
R140	C1
R146	C4
R147	B3
R148	C4
R149	B3
R155	C3
R159	C3
R160*	B2
R161*	A1
R163*	B1
R165	B1
R166	B2
R167*	A2
R169	B1
S109	A4

TP161	A2
TP162	A3
TP167	A3
TP169	C2
U101*	A5
U102B	B5
U106	A5
U107	B4
U110A	C4
U110B	C4
U112C	D5
U112D	C5
U113F	C5
U115B	D4
U122A	D3
U122B	D3
U122F	C3
U129	B3
U131A	B3
U131B	D2
U131C	D2
U132A	D2
U132B	D2
U141A	D4
U141B	D2
U141C	D1
U141D	D2
U142	D3
U146A	C3
U146B	D1
U148A	C4
U148B	C3
U151	D2
U152A	C1
U159A	C3
U159B	B2
U159C	C3
U160	B2
U161	A1
U162A	A2
U162B	A1
U163A	B2
U163B	D2
U163C	A2
U163D	A2
U164A	C1
U164B	C2
U165B,D	A2
U165C	A3
U166A	A3
U166B	A3
U167A	A3
U167B	B2
U167C	B2
U167D	A3

*See Parts List for serial number ranges.



SPG1 & 2

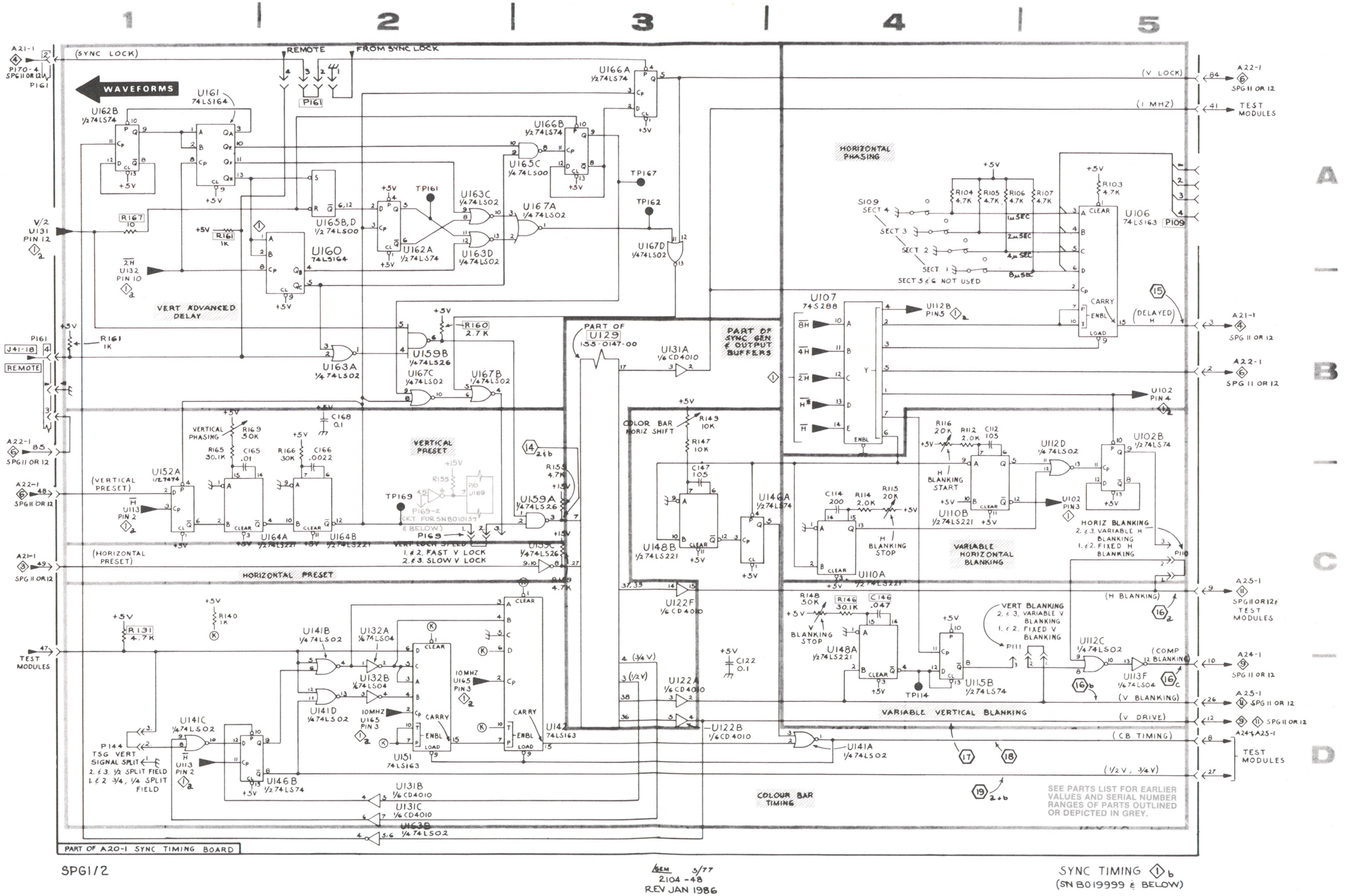
2104-25 REV JAN 1986

(SN B020000 & UP)
SYNC TIMING ⟨1⟩b

1b

SYNC TIMING PARTS LOCATING CHART

Part	Location
C112	B4
C114	C4
C122	D3
C146	C4
C147	C3
C165	C1
C166	C2
C168	B2
P110	C5
P111	D5
P144	D1
P161	A1
P161	B1
P169	C2
Q168	A1
R103	A5
R104	A4
R105	A4
R106	A4
R107	A5
R112	B4
R114	C4
R115	C4
R116	B4
R131	C1
R140	C1
R146	C4
R147	B3
R148	C4
R149	B3
R155	C3
R159	C3
R160	B2
R161	B1
R165	B1
R166	B2
R167	A1
R168	A1
R169	B1
S109	A4
TP114	D4
TP161	A2
TP162	A3
TP167	A3
TP169	C2
U102B	B5
U106	A5
U107	B4
U110A	C4
U110B	C4
U112C	D5
U112D	B5
U113F	D5
U115B	D4
U122A	D3
U122B	D3
U122F	C3
U129	B3
U131A	B3
U131B	D2
U131C	D2
U132A	D2
U132B	D2
U141A	D4
U141B	D2
U141C	D1
U141D	D2
U142	D3
U146A	C3
U146B	D1
U148A	C4
U148B	C3
U151	D2
U152A	C1
U159A	C3
U159B	B2
U159C	C3
U160	B2
U161	A1
U162A	A2
U162B	A1
U163A	B2
U163B	D2
U163C	A2
U163D	A2
U164A	C1
U164B	C2
U165B,D	A2
U165C	A3
U166A	A3
U166B	A3
U167A	A3
U167B	B2
U167C	B2
U167D	A3



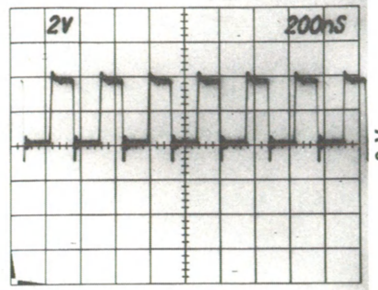
SPG1/2

2104-48 REV JAN 1986

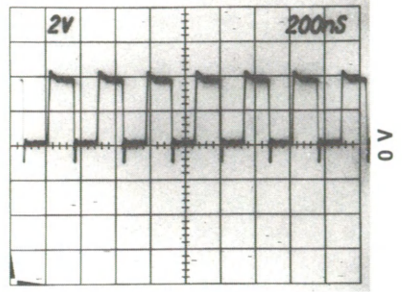
SYNC TIMING 1b (SN B019999 & BELOW)

SPG1/SPG2

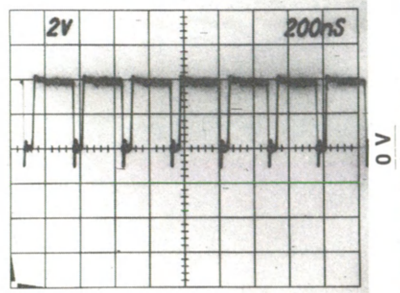
2a



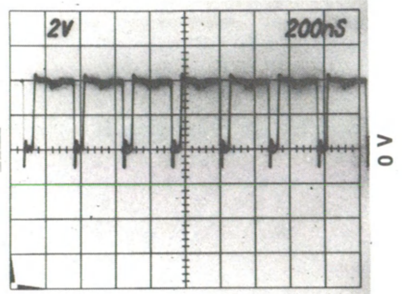
1 INT TRIG



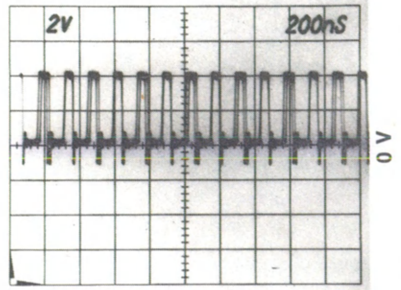
2 INT TRIG



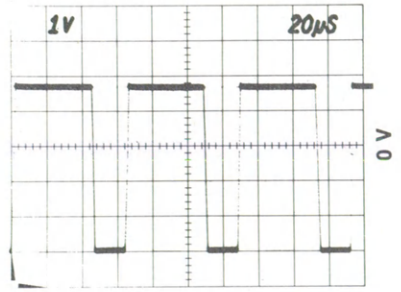
3 INT TRIG



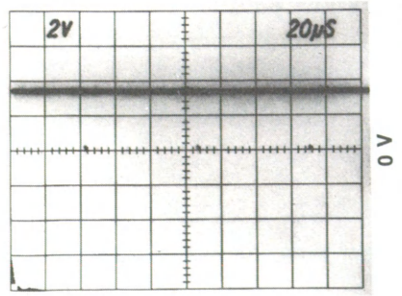
4 INT TRIG



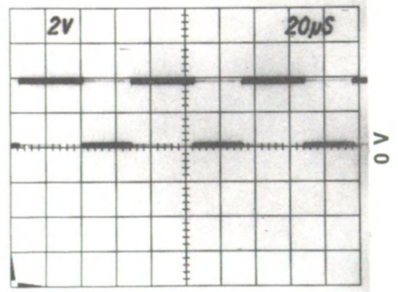
5 INT TRIG



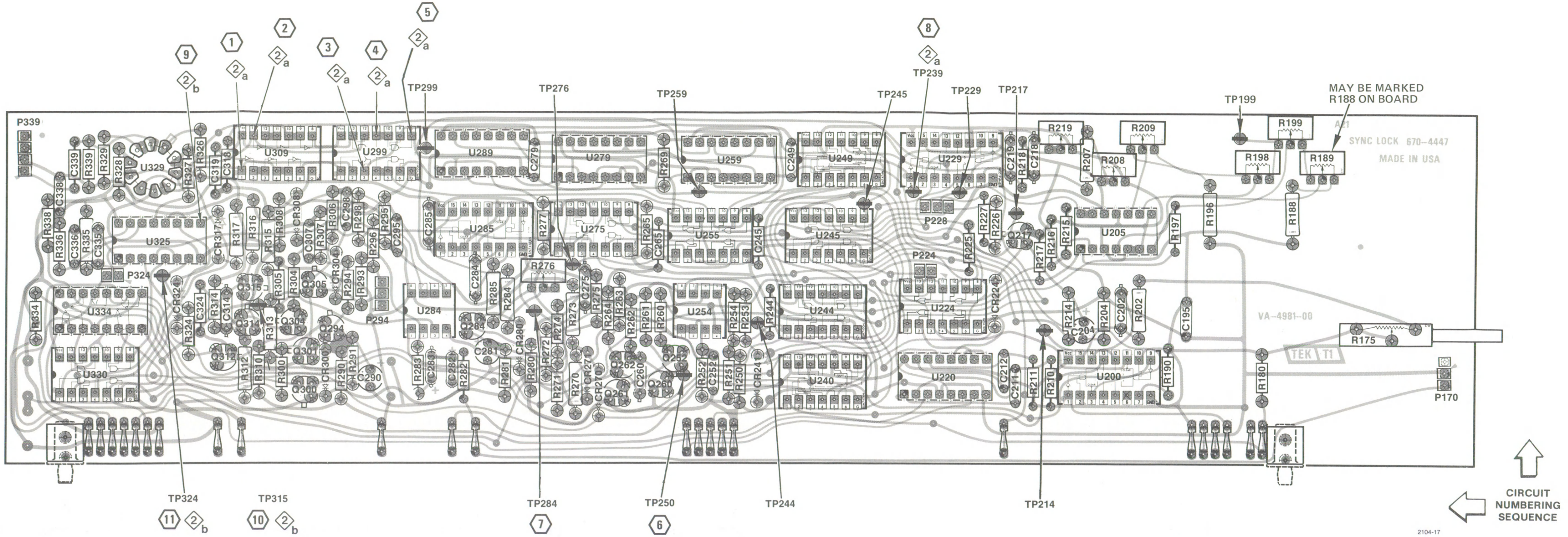
6 EXT MODE



7

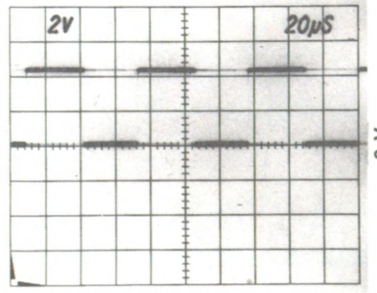


8

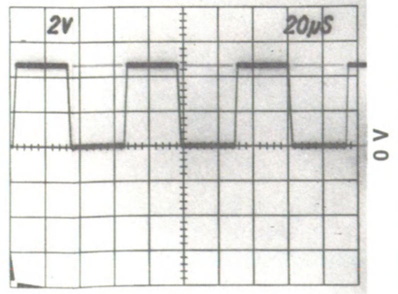


A21 SYNC LOCK CIRCUIT BOARD

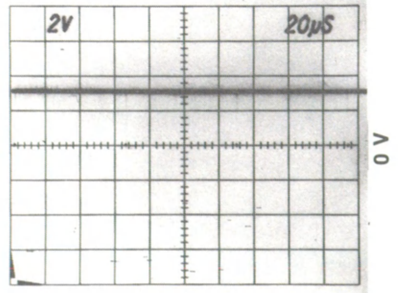
2b



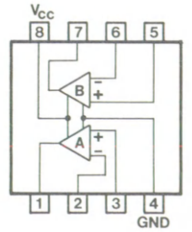
9



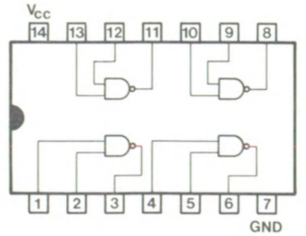
10



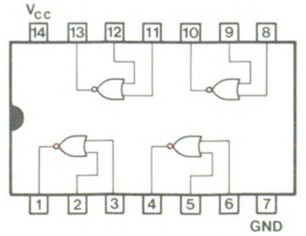
11



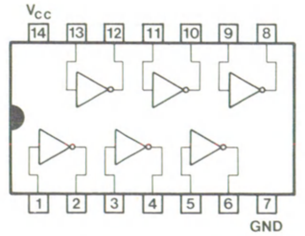
5558



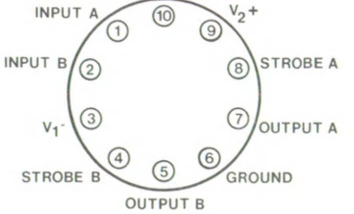
7400



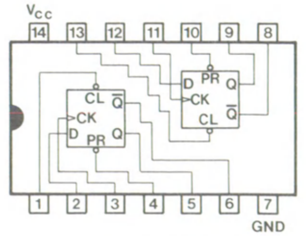
7402 or 74LS02



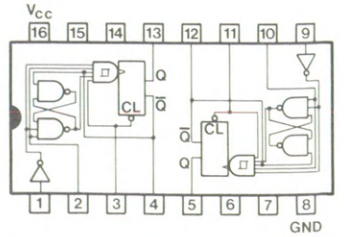
74LS04 or 7404



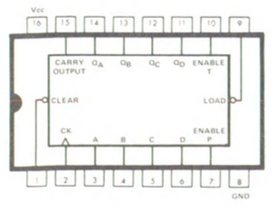
NE 529



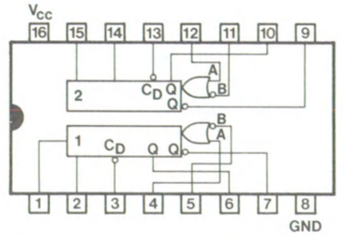
74LS74 or 7474



74LS221



74163 or 74LS163



96L02 or 9602

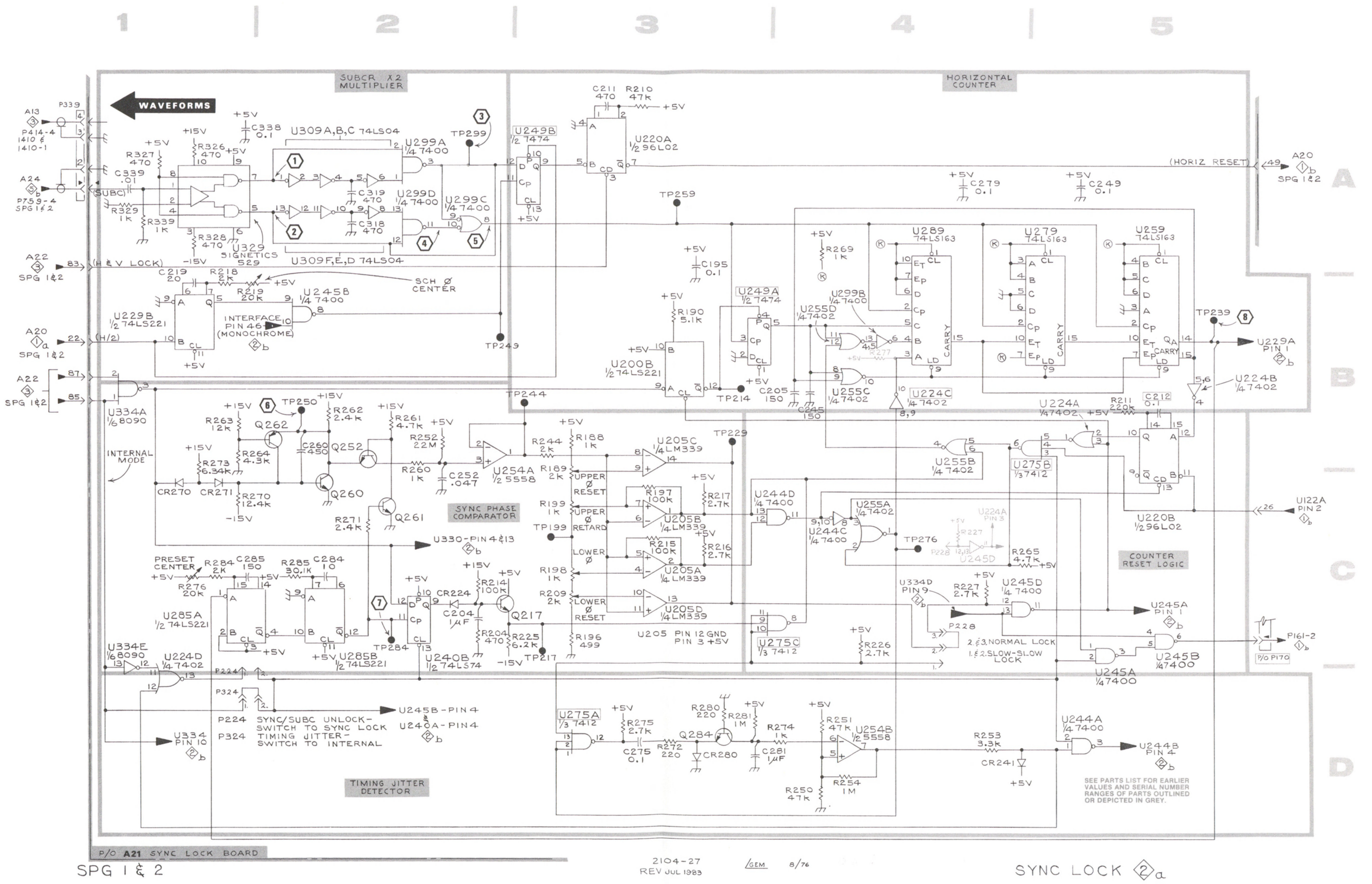
REV. A MAR 1978

2104-26

2a SYNC LOCK
PARTS LOCATING CHART

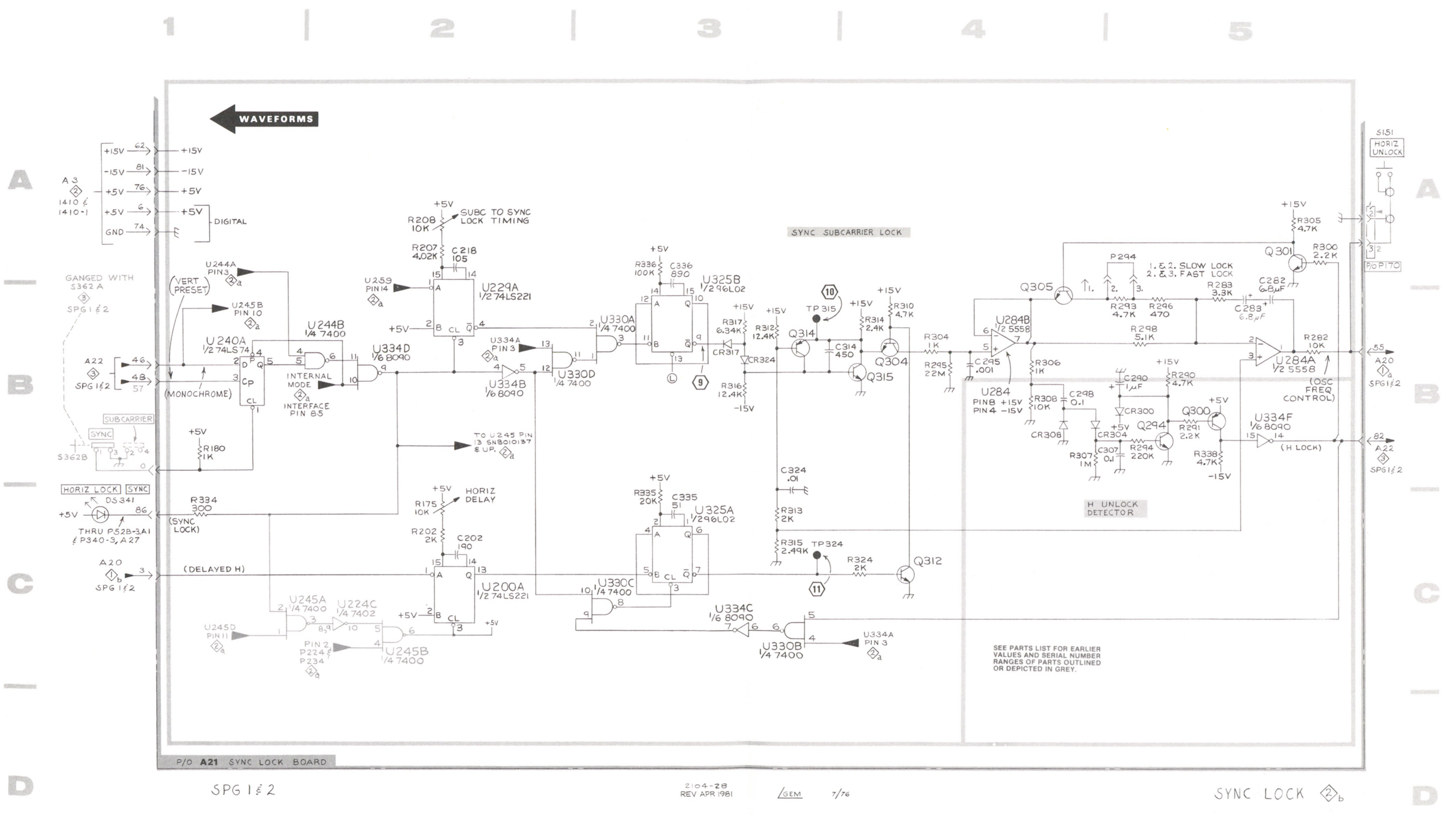
C195	3A	R199	3C	R285	2C	U229B	1B
C204	2C	R204	2C	R326	1A	U240B	2C
C205	4B	R209	3C	R327	1A	U244A	5D
C211	3A	R210	3A	R328	1A	U244C	4C
C212	5B	R211	5B	R329	1A	U244D	3C
C219	1B	R214	2C	R339	1A	U245A	5C
C245	4B	R215	3C			U245B	5C
C249	5A	R216	3C	TP199	3C	U245C	2B
C251	3D	R217	3C	TP214	3B	U245D	4C
C252	2C	R218	1B	TP217	3C	U249A	3B
C260	2B	R225	2C	TP229	3B	U249B	3A
C275	3D	R226	4C	TP239	5B	U254A	3B
C279	4A	R227	4C	TP244	3B	U254B	4D
C284	2C	R244	3B	TP250	2B	U255A	4C
C285	1C	R250	4D	TP259	3A	U255B	4B
C318	2A	R251	4D	TP276	4C	U255C	4B
C319	2A	R252	2B	TP284	2C	U255D	4B
C338	1A	R253	4D	TP299	2A	U259	4A
C339	1A	R254	4D			U275A	3D
		R260	2B	Q217	2C	U275B	4B
CR224	2C	R261	2B	Q252	2B	U275C	3C
CR241	4D	R262	2B	Q260	2C	U279	4A
CR270	1C	R263	1B	Q261	2C	U285A	1C
CR271	1C	R264	1B	Q262	2B	U285B	2C
CR280	3D	R265	4C	Q284	3D	U289	4A
		R269	4A			U299A	2A
P170	5C	R270	1C	U200B	3B	U299B	4B
P224	1D	R271	2C	U205A	3C	U299C	2A
P228	4C	R272	3D	U205B	3C	U299D	2A
P324	1D	R273	1B	U205C	3B	U309A	2A
		R274	4D	U205D	3C	U209B	2A
R188	3B	R275	3D	U220A	3A	U309C	2A
R189	3C	R276	1C	U220B	5C	U309D	2A
R190	3B	R277*	4B	U224A	5B	U309E	2A
R196	3C	R280	3D	U224B	5B	U309F	2A
R197	3C	R281	3D	U224C	4B	U329	1A
R198	3C	R284	1C	U224D	1D	U334A	1B
						U334E	1D

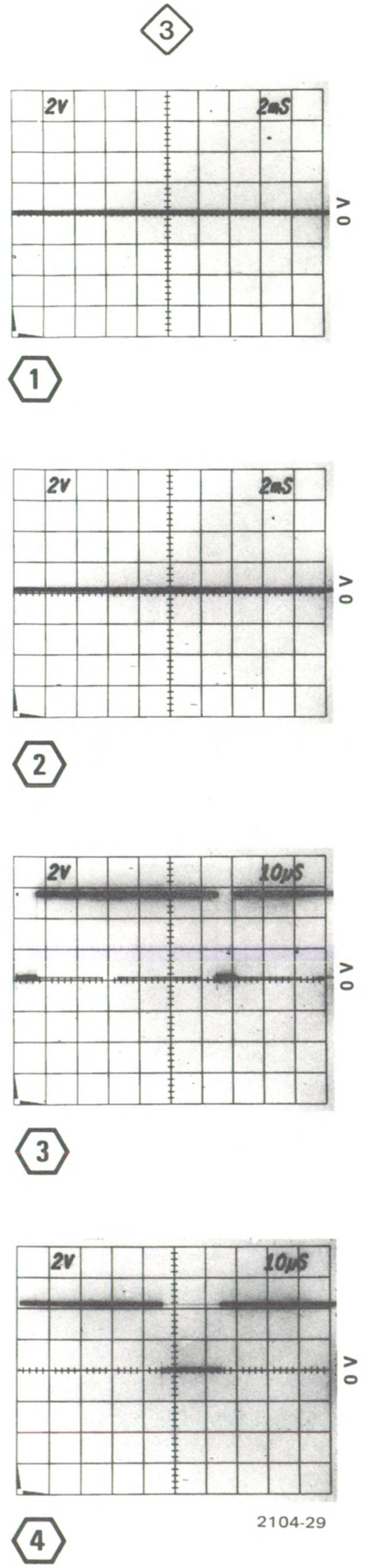
*See Parts List for serial number ranges.

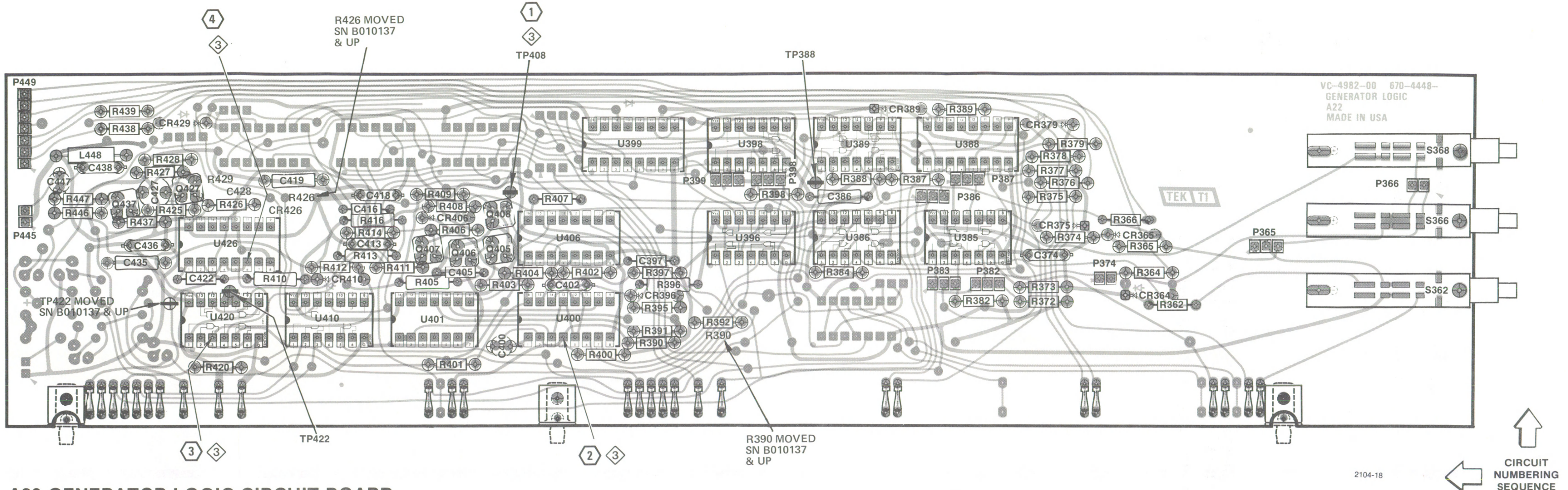


⟨2⟩b SYNC LOCK
PARTS LOCATING CHART

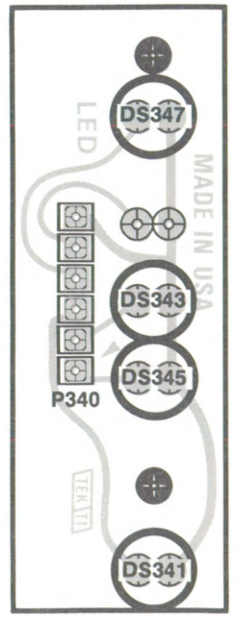
C202	C2
C218	A2
C282	B5
C283	B5
C290	B5
C295	B4
C298	B4
C307	B5
C314	B3
C324	B3
C335	C3
C336	A3
CR300	B5
CR304	B5
CR308	B4
CR317	B3
CR324	B3
DS341	C1
P170	A5
P294	A5
Q294	B5
Q300	B5
Q301	A5
Q304	B4
Q305	A4
Q312	C4
Q314	B3
Q315	B4
R175	C2
R180	B1
R202	C2
R207	A2
R208	A2
R282	B5
R283	B5
R290	B5
R291	B5
R293	B5
R294	B5
R295	B4
R296	B5
R298	B5
R300	A5
R304	B4
R305	A5
R306	B4
R307	B4
R308	B4
R310	B4
R312	B3
R313	C3
R314	B4
R315	C3
R316	B3
R317	B3
R324	C4
R334	C1
R335	B3
R336	A3
R338	B5
S151	A5
S362B	B1
TP315	B3
TP324	C3
U200A	C2
U224C	C2
U229A	A2
U240A	B1
U244B	B2
U245A	C1
U245B	C2
U284A	B5
U284B	B4
U325A	C3
U325B	A3
U330A	B3
U330B	C3
U330C	C3
U330D	B2
U334B	B2
U334C	C3
U334D	B2
U334F	B5



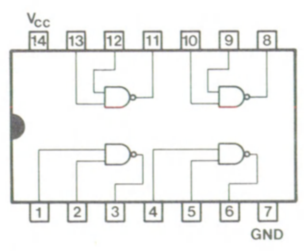




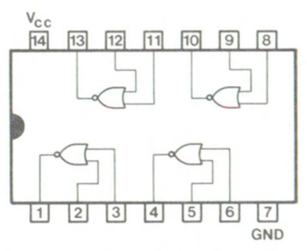
A22 GENERATOR LOGIC CIRCUIT BOARD



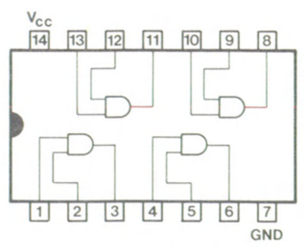
A27 LED CIRCUIT BOARD



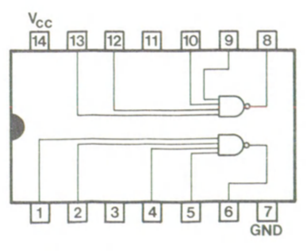
7400



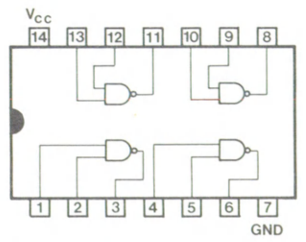
7402 or 74LS02



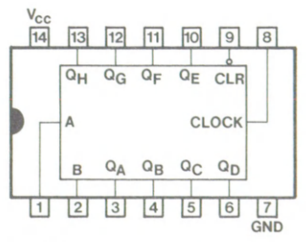
7408 or 74LS08



7420

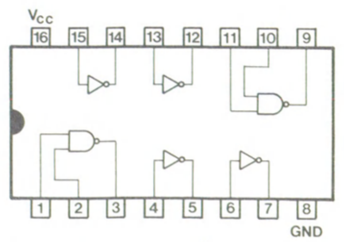


7426

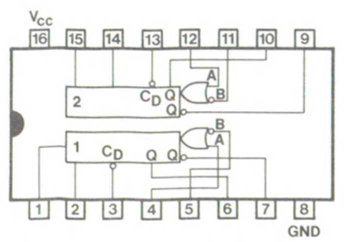


74164 or 74LS164

REV APR 1981



8090



96L02 or 9602

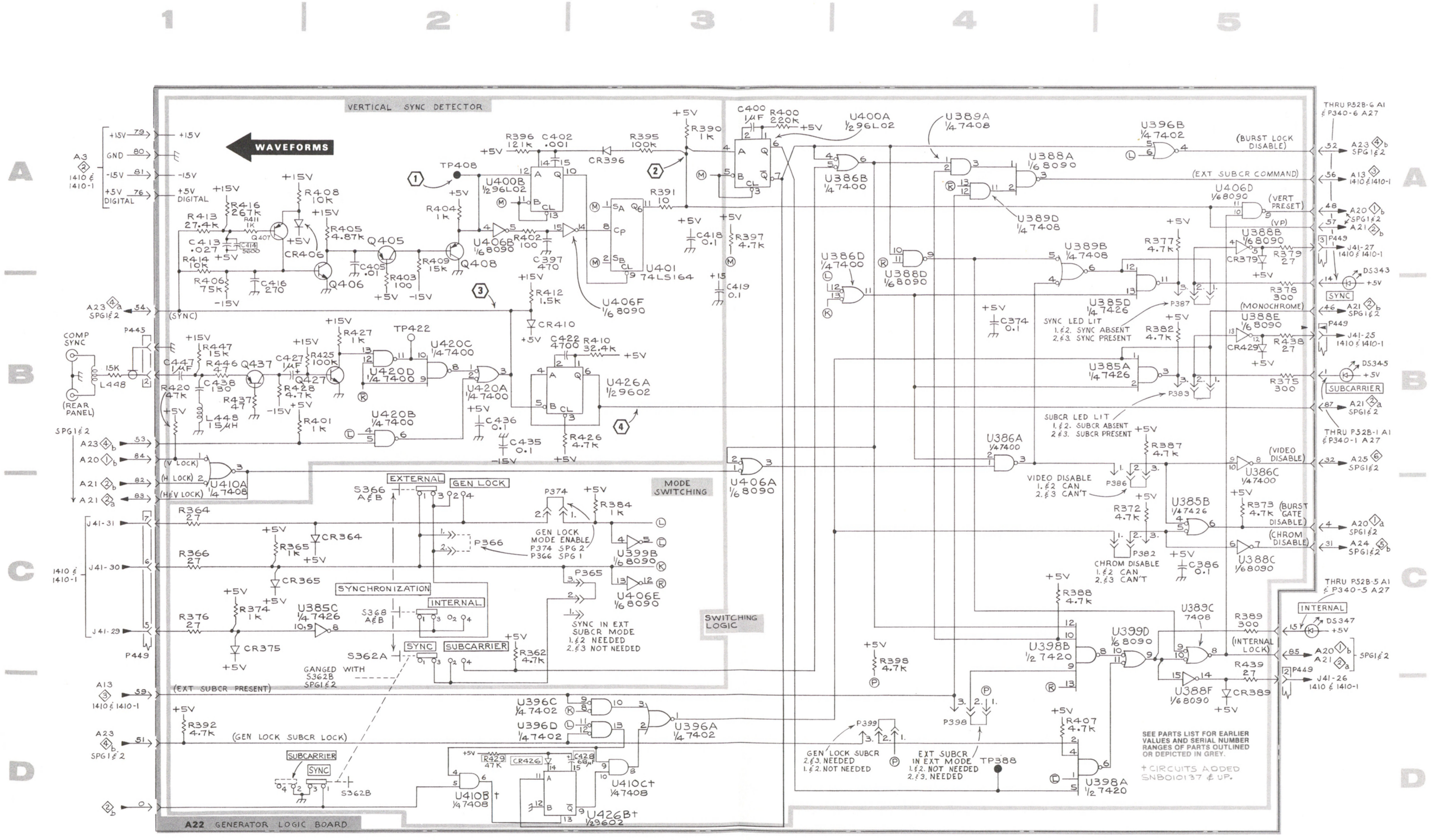
◇3 GENERATOR LOGIC PARTS LOCATING CHART

C374	4B
C386	5C
C397	2A
C400	3A
C402	2A
C405	2A
C413	1A
C414*	1A
C418	3A
C419	3B
C422	2B
C427	1B
C428	2D
C435	2B
C436	2B
C438	1B
C447	1B
CR364	2C
CR365	1C
CR375	1C
CR379	5A
CR389	5D
CR396	3A
CR406	1A
CR410	2B
CR426*	2D
CR429	5B
L448	1B
P365	3C
P366	2C
P374	2C
P382	5C
P383	5B
P386	5C
P387	5B
P398	4D
P399	4D
Q405	2A
Q406	2A
Q407	1A
Q408	2A
Q427	2B
Q433	1B

R362	2C
R364	1C
R365	1C
R366	1C
R372	5C
R373	5C
R374	1C
R375	5B
R376	1C
R377	5A
R378	5B
R379	5A
R382	5B
R384	4C
R387	5B
R388	4C
R389	5B
R390	3A
R391	3A
R392	1D
R395	3A
R396	2A
R397	3A
R398	4C
R400	3A
R401	1B
R402	2A
R404	2A
R405	2A
R407	4D
R408	1A
R409	2A
R410	3B
R411	1A
R412	2B
R413	1A
R414	1A
R416	1A
R420	1B
R425	2B
R426	2B
R427	2B
R428	1B
R429*	2D
R437	1B
R438	5B
R439	5D
R446	1B
R447	1B

S362A	2C
S362B	2D
S366	2C
S368A	2C
TP388	4D
TP408	2A
TP422	2B
U385A	5B
U385B	5C
U385C	2C
U385D	5B
U386A	4B
U386B	4A
U386C	5B
U386D	4B
U388A	4A
U388C	5C
U388D	4A
U388E	5B
U388F	5D
U389A	4A
U389B	4A
U389C	5C
U389D	4A
U396A	3D
U396B	5A
U396C	3D
U396D	3D
U398A	4D
U398B	4C
U399B	3C
U399D	5C
U400A	3A
U400B	2A
U401A	3A
U406A	3B
U406B	2A
U406D	5A
U406E	3C
U410A	1C
U410B	2D
U410C	3D
U420A	2B
U420B	2B
U420C	2B
U420D	2B
U426A	2B
U426B	3D

*See Parts List for serial number ranges.

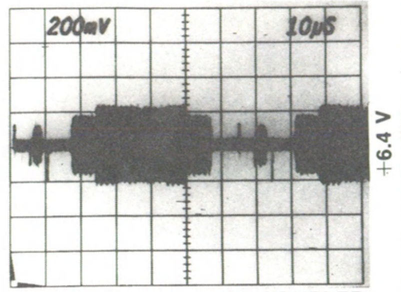


SPG1 & 2 — 2104-30 — REV AUG 1982 — 9/76

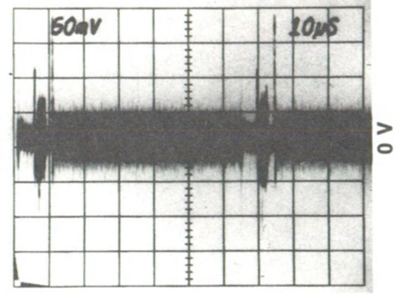
VERTICAL SYNC & GENERATOR LOGIC ◇3

SPG1/SPG2

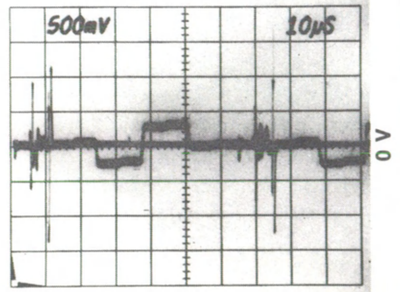
4a



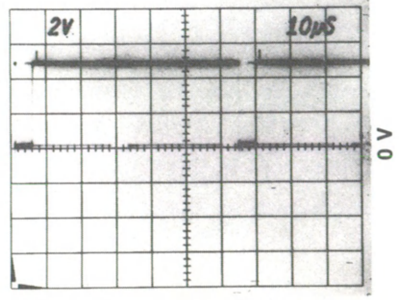
1



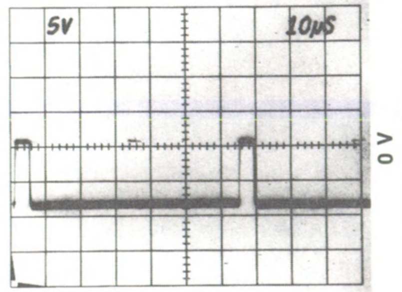
2



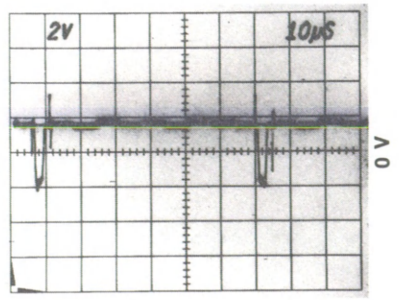
3



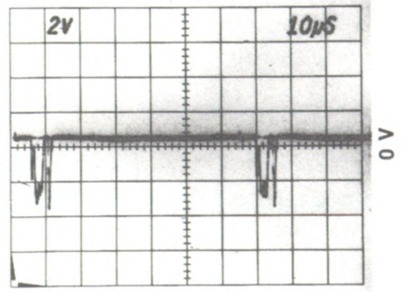
4



5

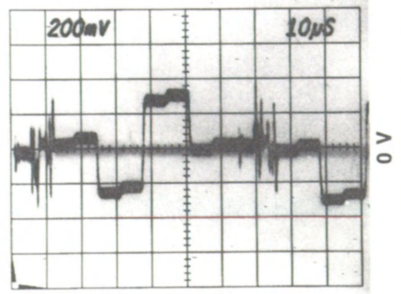


6

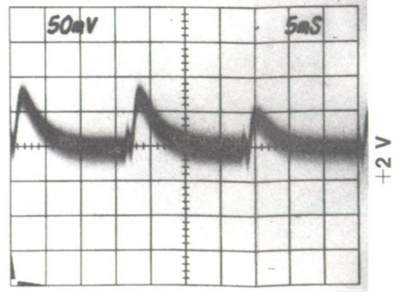


7

4b

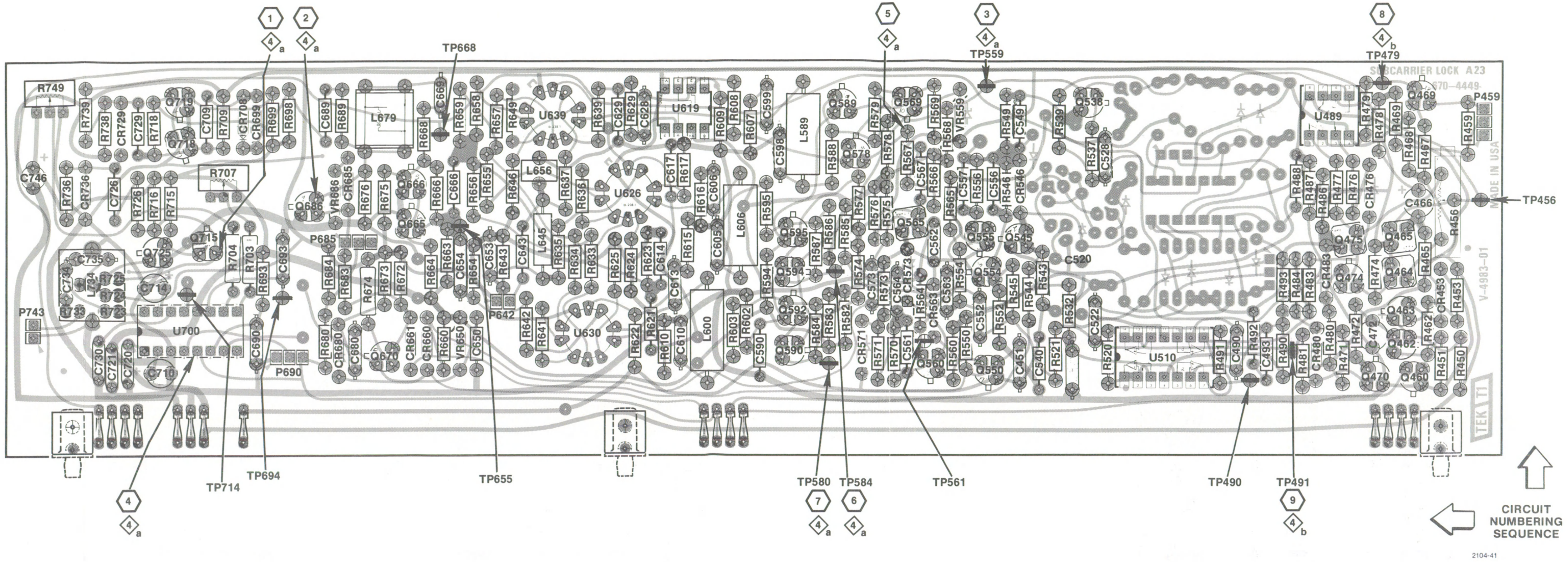


8

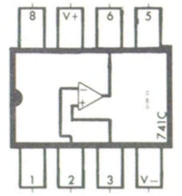


9

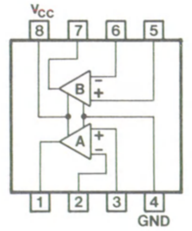
2104-31



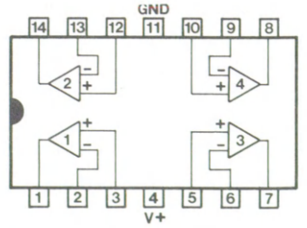
A23 SUBCARRIER LOCK CIRCUIT BOARD SN B021076 & UP



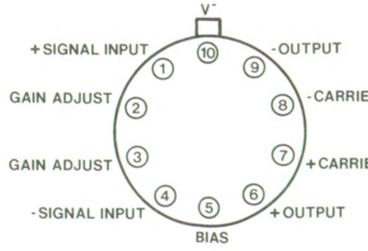
741



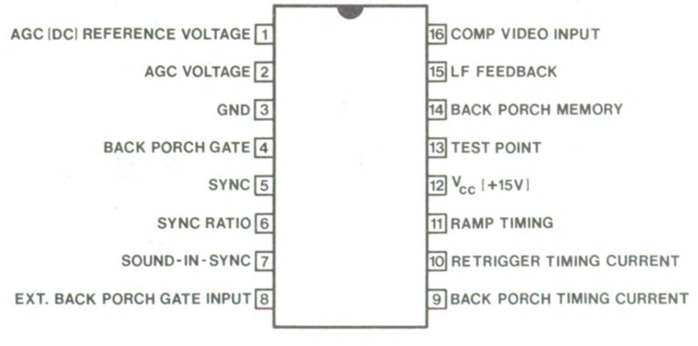
5558



LM324



MC1496G



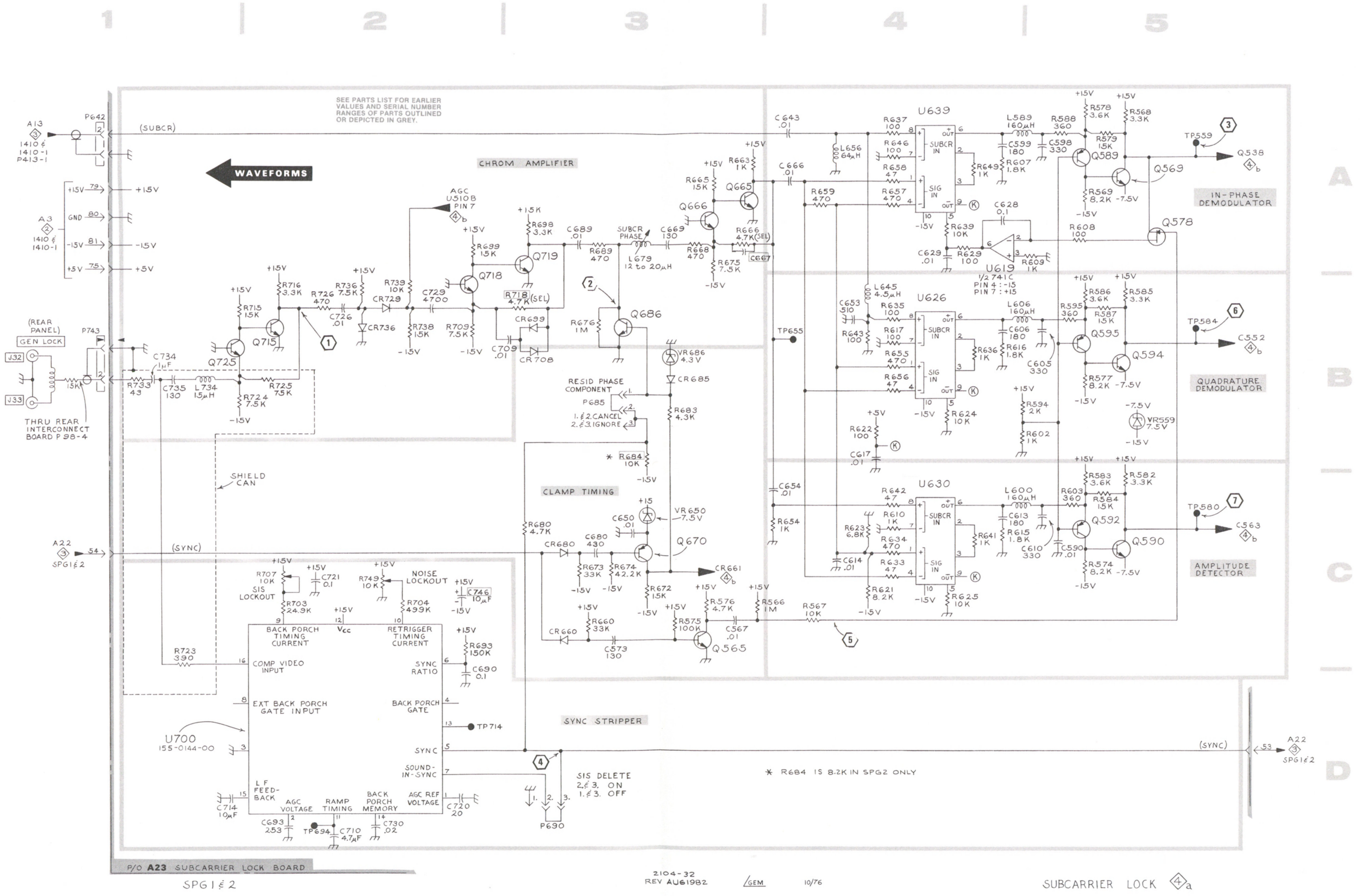
155-0144-00

REV APR 1981

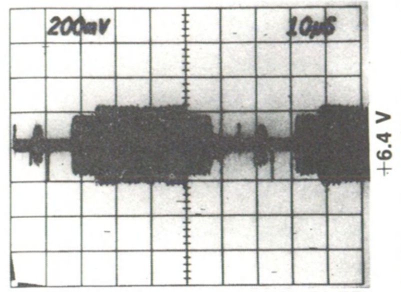
4a SUBCARRIER LOCK PARTS LOCATING CHART

Part	Location
C567	3C
C573	3C
C590	5C
C598	5A
C599	4A
C605	5B
C606	4B
C610	5C
C613	4C
C614	4C
C617	4B
C628	4A
C629	4A
C643	4A
C650	3C
C653	4B
C654	4C
C666	4A
C667*	3A
C669	3A
C680	3C
C689	3A
C690	2D
C693	2D
C709	3B
C710	2D
C714	1D
C720	2D
C721	2C
C726	2B
C729	2B
C730	2D
C734	1B
C735	1B
C746	2D
CR660	3C
CR680	3C
CR685	3B
CR699	3B
CR708	3B
CR729	2B
CR736	2B
L589	4A
L600	4C
L606	4B
L645	4B
L656	4A
L679	3A
L734	1B
P685	3B
P690	3D
Q565	3C
Q569	5A
Q578	5A
Q589	5A
Q590	5C
Q592	5C
Q594	5B
Q595	5B
Q670	3C
Q665	3A
Q666	3A
Q686	3B
Q715	2B
Q718	2B
Q719	3A
Q725	1B
R566	3C
R567	4C
R568	5A
R569	5A
R574	3C
R575	3C
R576	3C
R577	5B
R578	5A
R579	5A
R582	5C
R583	5C
R584	5C
R585	5B
R586	5B
R587	5B
R588	5A
R594	5B
R595	5B
R602	5B
R603	5C
R607	4A
R608	5A
R609	5A
R610	4C
R615	4C
R616	4B
R617	4B
R621	4C
R622	4B
R623	4C
R624	4B
R625	4C
R629	4A
R633	4C
R634	4C
R635	4B
R636	4B
R637	4A
R639	4A
R641	4C
R642	4C
R643	4B
R646	4A
R649	4A
R654	4C
R655	4B
R656	4B
R657	4A
R658	4A
R659	4A
R660	3C
R663	3A
R665	3A
R666	3A
R668	3A
R672	3C
R673	3C
R674	3C
R675	3A
R676	3B
R680	3C
R683	3B
R684	3B
R689	3A
R693	2C
R698	3A
R699	2A
R703	2C
R704	2C
R707	2C
R709	2B
R715	2B
R716	2B
R718	3B
R723	1C
R724	2B
R725	2B
R726	2B
R733	1B
R736	2B
R738	2B
R739	2B
R749	2C
TP559	5A
TP558	5C
TP584	5B
TP655	4B
TP694	2D
TP714	2D
U619	4A
U626	4B
U630	4C
U639	4A
U700	2D
VR559	5B
VR650	3C
VR686	3B

*See Parts List for serial number ranges.

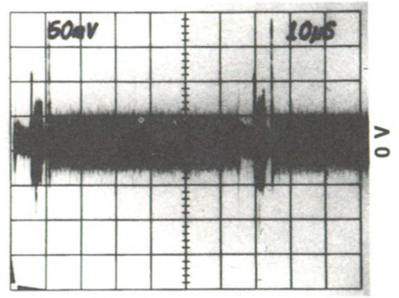


4a

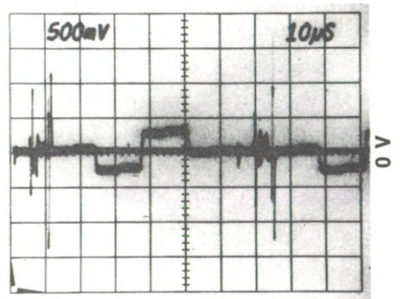


AC COUPLED

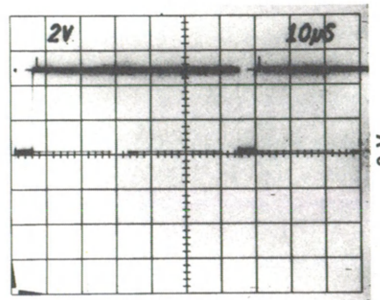
1



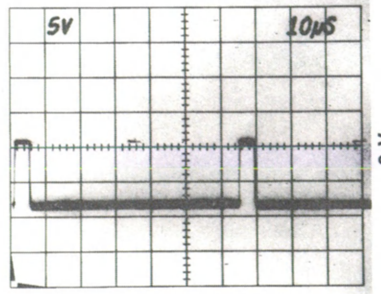
2



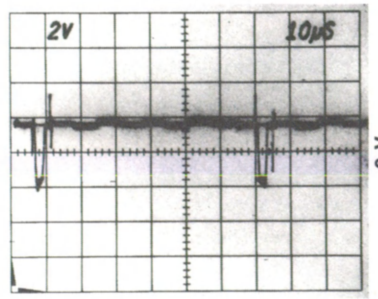
3



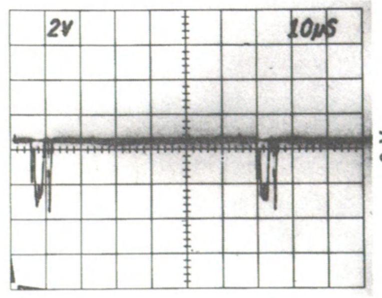
4



5

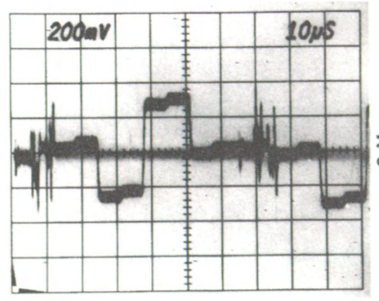


6

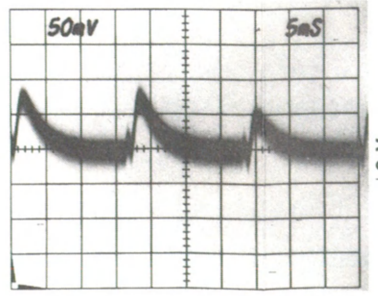


7

4b



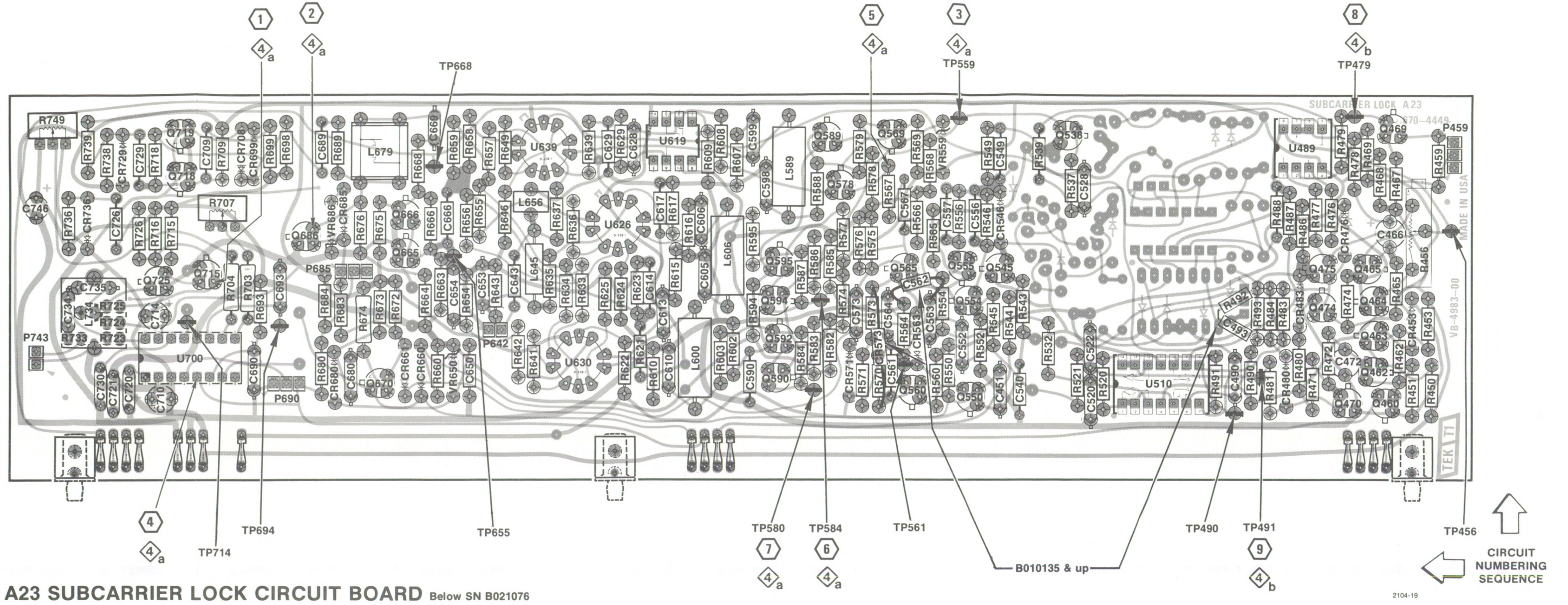
8



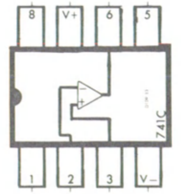
AC COUPLED

9

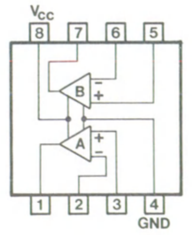
2104-31



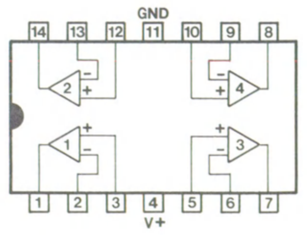
A23 SUBCARRIER LOCK CIRCUIT BOARD Below SN B021076



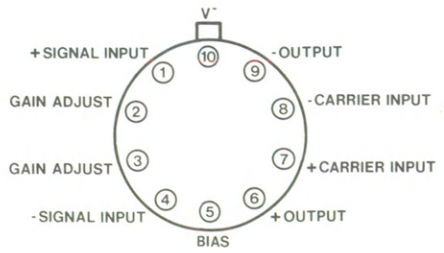
741



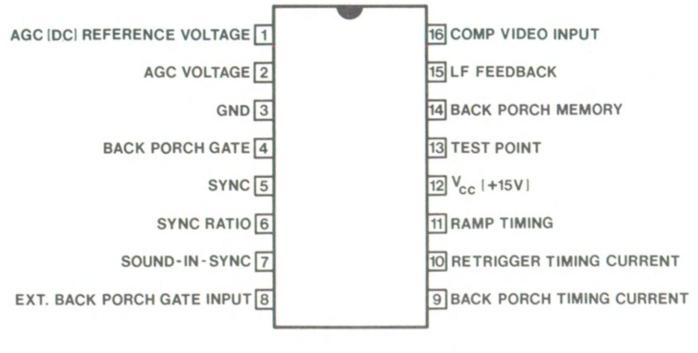
5558



LM324



MC1496G

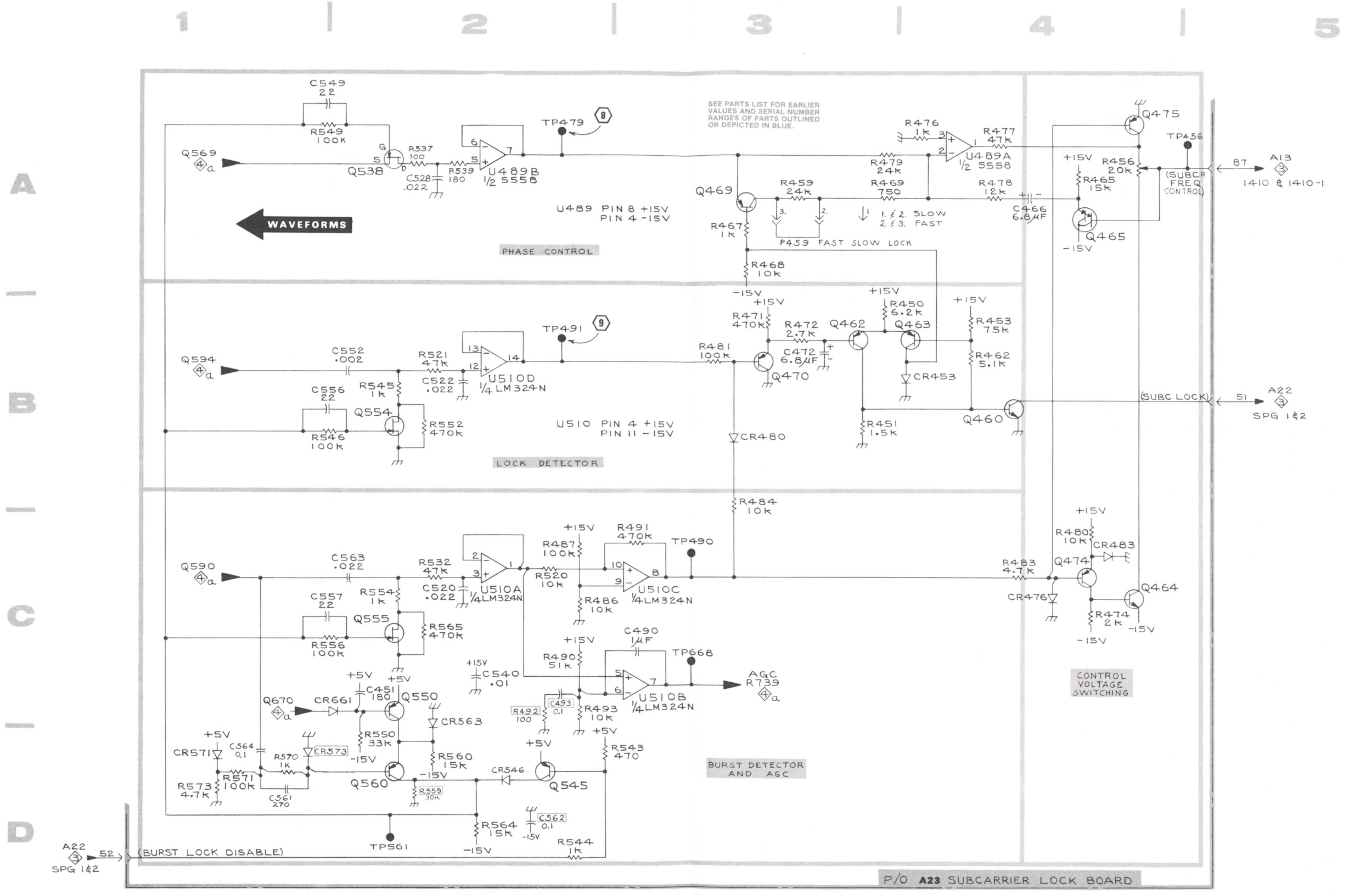


155-0144-00

⟨4⟩b

SUBCARRIER LOCK PARTS LOCATING CHART

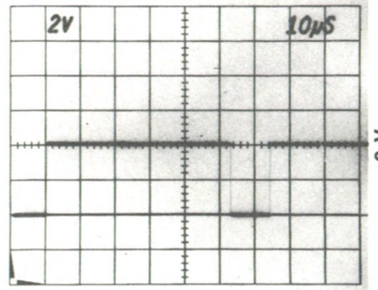
C451	C2
C466	A4
C472	B3
C490	C3
C493	C2
C520	C2
C522	B2
C528	A2
C540	C2
C549	A1
C552	B2
C556	B1
C557	C1
C561	D1
C562	D2
C563	C2
C564	D1
CR453	B4
CR476	C4
CR480	B3
CR563	C2
CR571	D1
CR573	D1
CR661	C2
P459	A3
Q460	B4
Q462	B3
Q463	B4
Q464	C4
Q465	A4
Q469	A3
Q470	B3
Q474	C4
Q475	A4
Q538	A2
Q545	D2
Q550	C2
Q554	B2
Q555	C2
Q560	D2
R450	B3
R451	B3
R453	B4
R456	A4
R459	A3
R462	B4
R465	A4
R467	A3
R468	A3
R469	A3
R471	B3
R472	B3
R474	C4
R476	A4
R477	A4
R478	A4
R479	A3
R480	C4
R481	B3
R483	C4
R484	B3
R486	C2
R487	C2
R490	C2
R491	C3
R492	C2
R493	C2
R520	C2
R521	B2
R532	C2
R537	A2
R539	A2
R543	D2
R544	D2
R545	D2
R546	B1
R549	A1
R550	D2
R552	B2
R554	C2
R556	C1
R560	D2
R564	D2
R565	C2
R570	D1
R571	D1
R573	D1
TP456	A5
TP479	A2
TP490	C3
TP491	B2
TP561	D2
TP668	C3
U489A	A4
U489B	A2
U510A	C2
U510B	C3
U510C	C3
U510D	B2



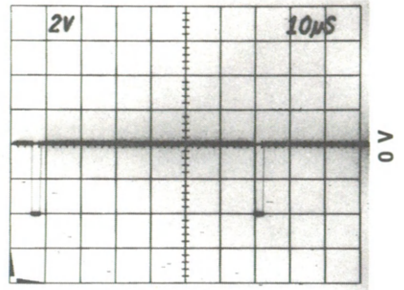
2104-33 REV JAN 1986 GEM 10/76

5a

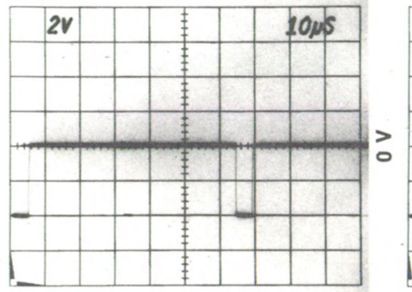
WAVEFORMS 1 THROUGH 6 TAKEN AT FRONT AND REAR PANEL CONNECTORS



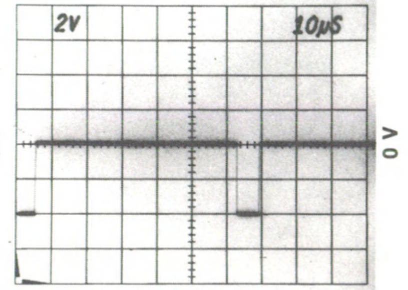
1



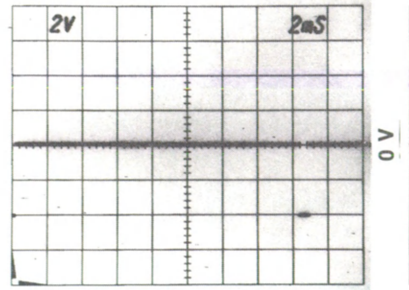
2



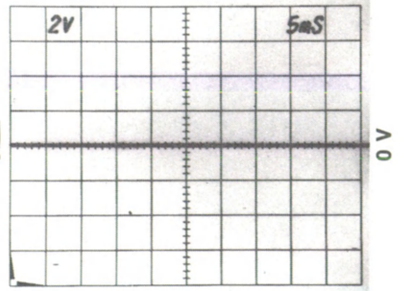
3



4

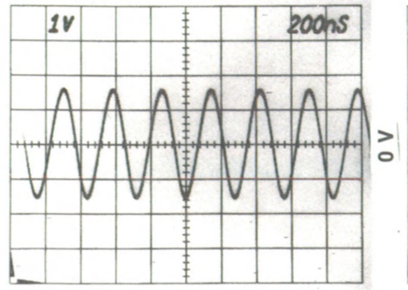


5

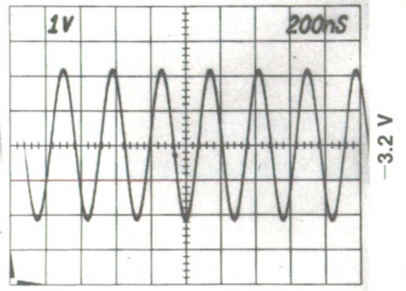


6

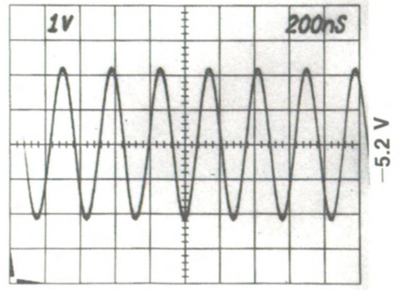
5b



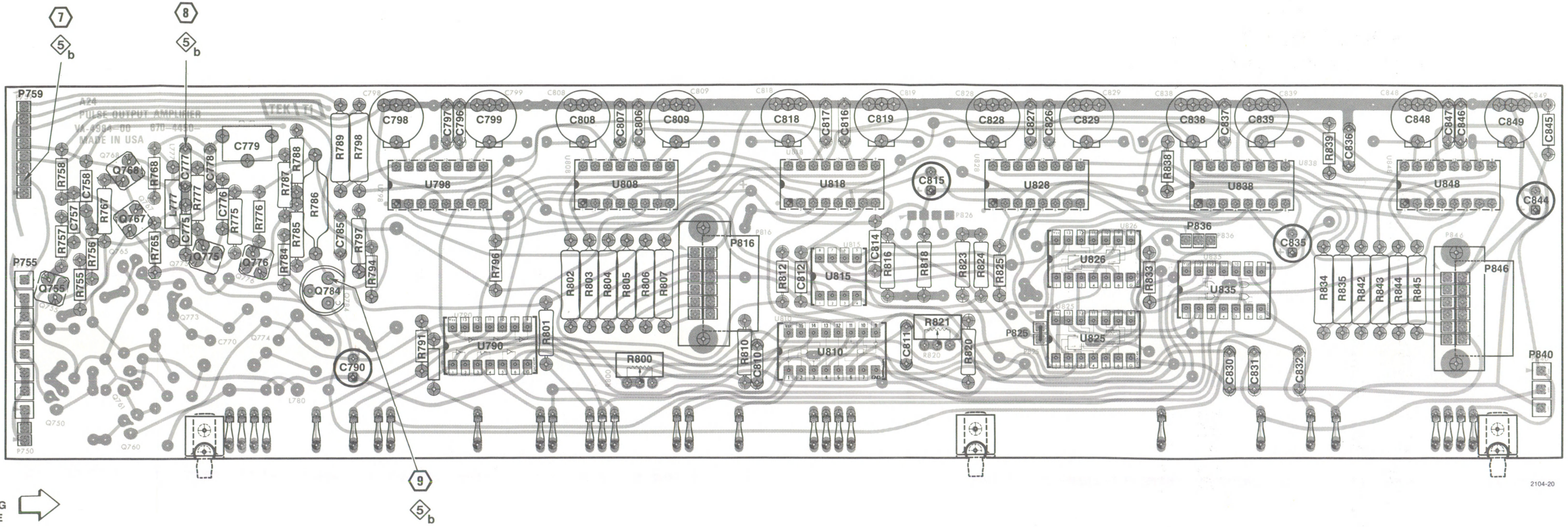
7



8

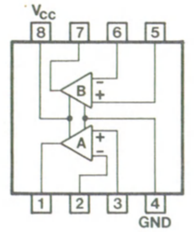


9

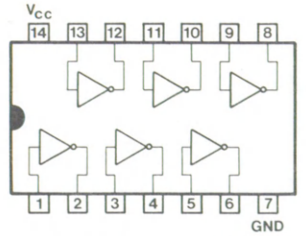


CIRCUIT NUMBERING SEQUENCE

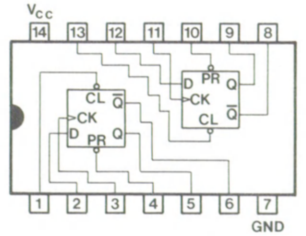
A24 PULSE OUTPUT AMPLIFIER CIRCUIT BOARD



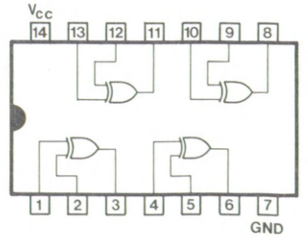
5558



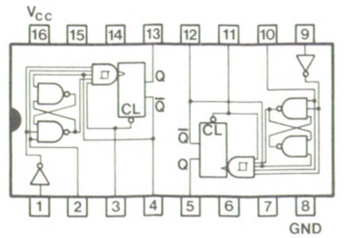
74LS04 or 7404



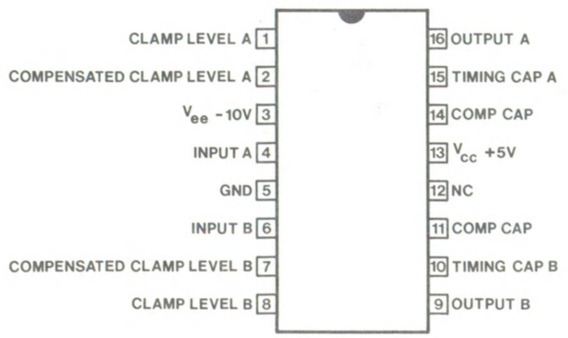
74LS74 or 7474



7486 or 74LS86



74LS221 or 74221



155-0145-00

2104-34

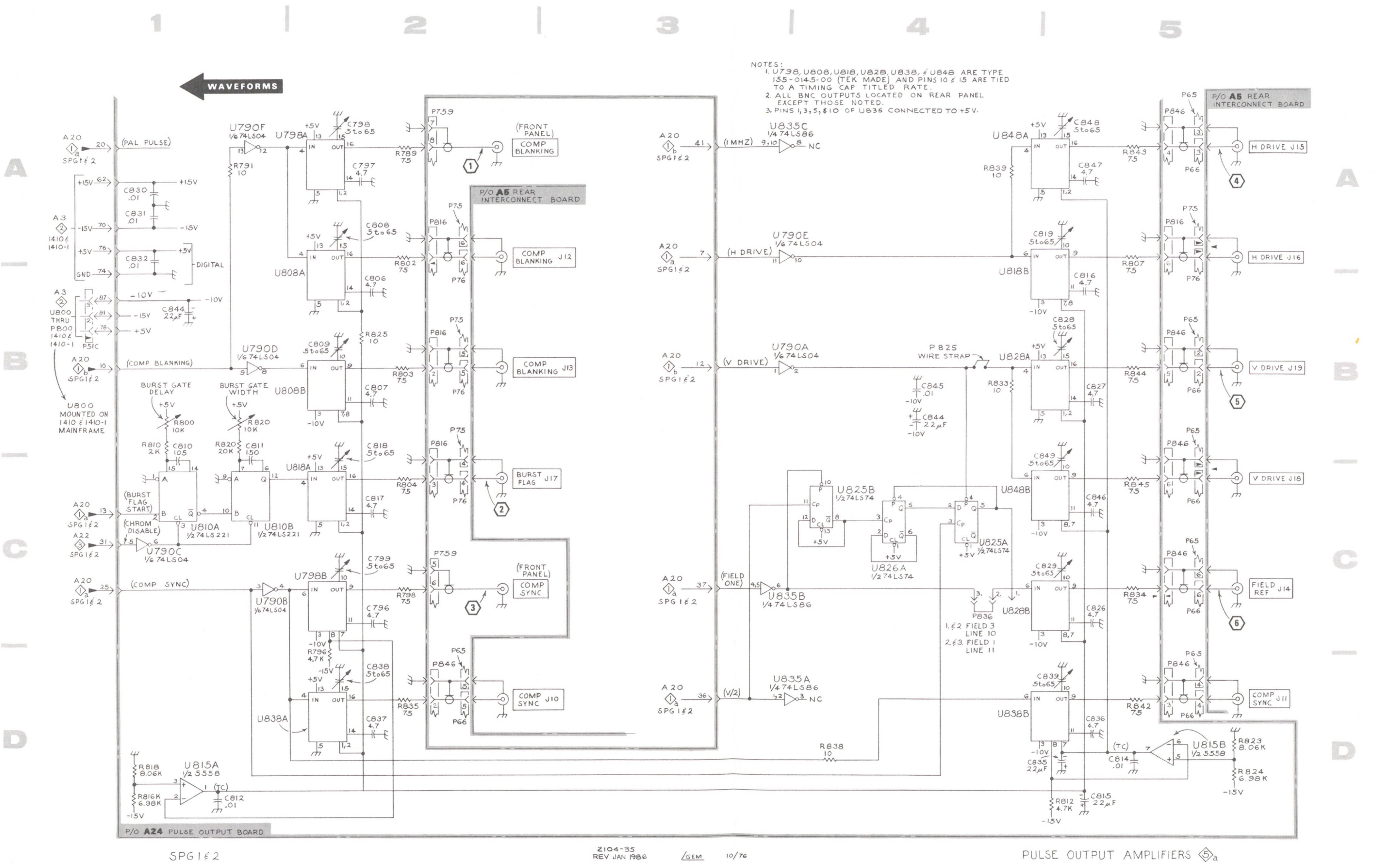
5a

PULSE OUTPUT AMPLIFIER PARTS LOCATING CHART

C796	2C
C797	2A
C798	2A
C799	2C
C806	2B
C807	2B
C808	2A
C809	2B
C810	1D
C811	1D
C812	1D
C814	5D
C815	5D
C816	5B
C817	2C
C818	2C
C819	5A
C826	5C
C827	5B
C828	5B
C829	5C
C830	1C
C831	1C
C832	1C
C835	5D
C836	5D
C837	2D
C838	2D
C839	5D
C844	4B
C845	4B
C846	5A
C847	5C
C848	5A
C849	5B
P65	5C
P65	5B
P65	5A
P65	5D
P65	5C
P66	D2
P66	5C
P66	5B
P66	5A
P66	5D
P66	5C
P75	5A
P75	2C
P75	2B
P75	2A
P76	5A
P76	2C
P76	2B
P76	2A
P759	2C
P759	2A
P759	2A
P816	5A
P816	2C
P816	2B

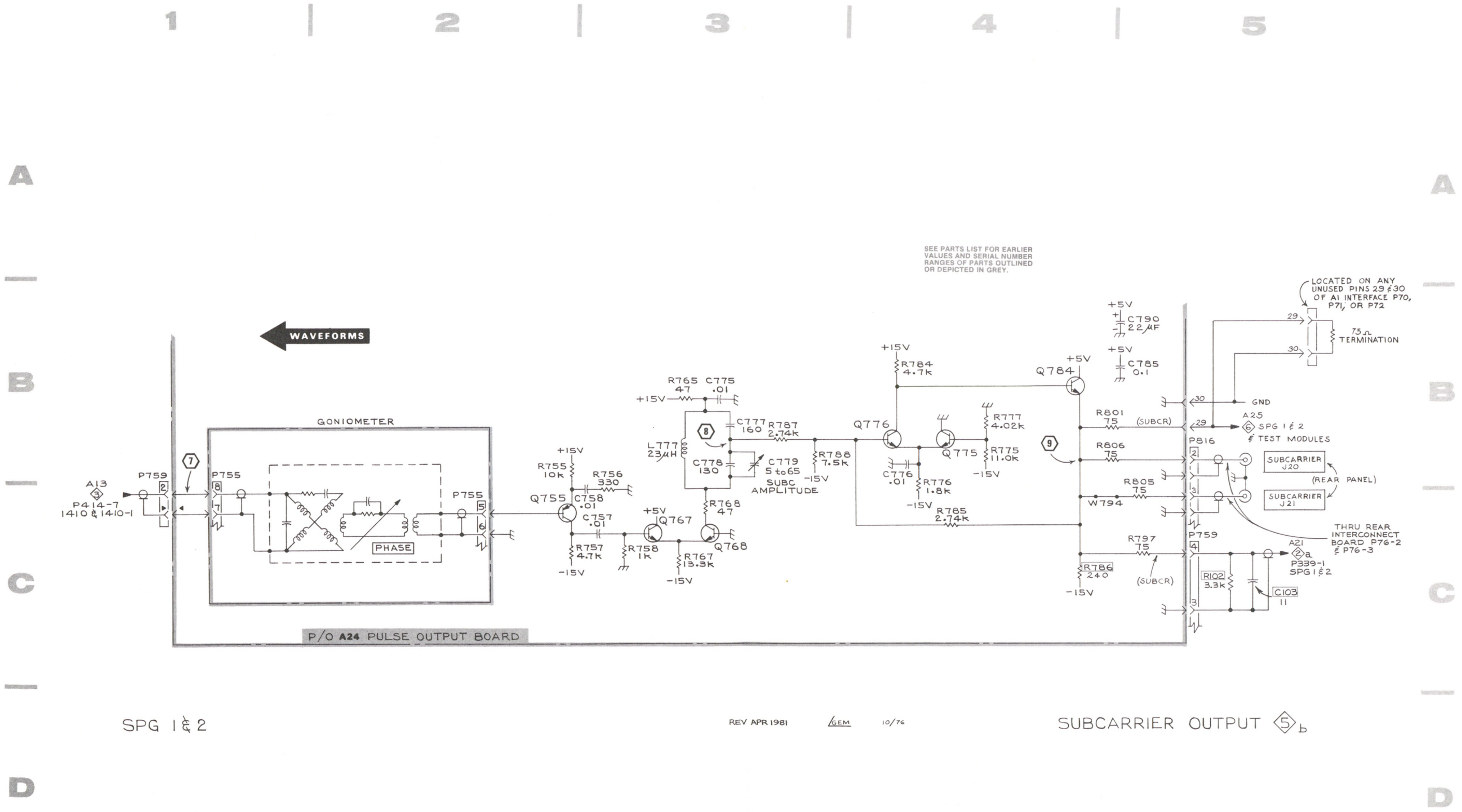
P816	2A
P825	4B
P836	4C
P846	5C
P846	5B
P846	5A
P846	5D
P846	2D
P846	5C
R789	2A
R791	1A
R796	2D
R798	2C
R800	1B
R802	2A
R803	2B
R804	2C
R807	5A
R810	1B
R812	5D
R816	1D
R818	1D
R820	1B
R821	1B
R823	5D
R824	5D
R825	2B
R833	4B
R834	4C
R835	2D
R838	4D
R839	4A
R842	5D
R843	5A
R844	4B
R845	4C
U790A	3B
U790B	1C
U790C	1C
U790D	1B
U790E	3A
U790F	1A
U798A	2A
U798B	2C
U808A	2B
U808B	2B
U810A	1C
U810B	1C
U815A	1D
U815B	5D
U818A	2C
U818B	4B
U825A	4C
U825B	4C
U826A	4C
U828A	4B
U828B	4C
U835A	3D
U835B	3C
U835C	3A

U838A	2D
U838B	4D
U848A	4A
U848B	4C



5 b
PULSE OUTPUT AMPLIFIER PARTS LOCATING CHART

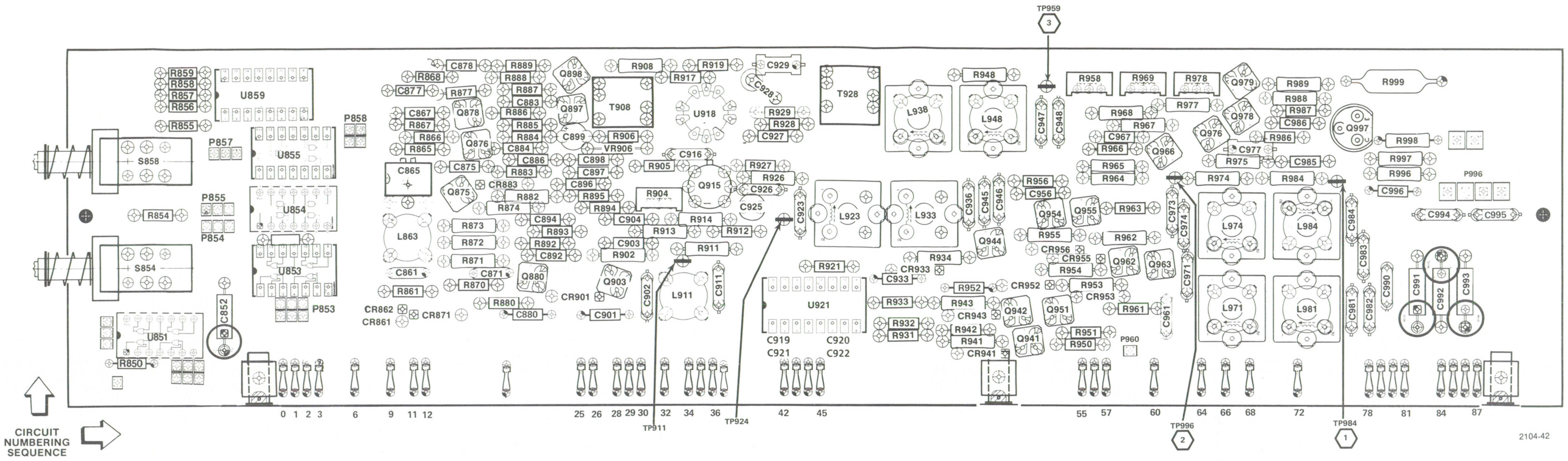
C757	3C
C758	3C
C775	3B
C776	4B
C777	3B
C778	3B
C779	3B
C785	5B
C790	5B
L777	3B
Q755	2C
Q767	3C
Q768	3C
Q775	4B
Q776	4B
Q784	4B
R755	2B
R756	3C
R757	2C
R758	3C
R765	3B
R767	3C
R768	3C
R775	4B
R776	4B
R777	4B
R784	4B
R785	4C
R786	4C
R787	3B
R788	3B
R797	5C
R801	4B
R805	5C
R806	4B
W794	4C



SPG 1 & 2

REV APR 1981

SUBCARRIER OUTPUT 5 b



A25 VIRS/BLACK BURST CIRCUIT BOARD (SN B020211 & UP-SPG1)
(SN B021237 & UP-SPG2)

6

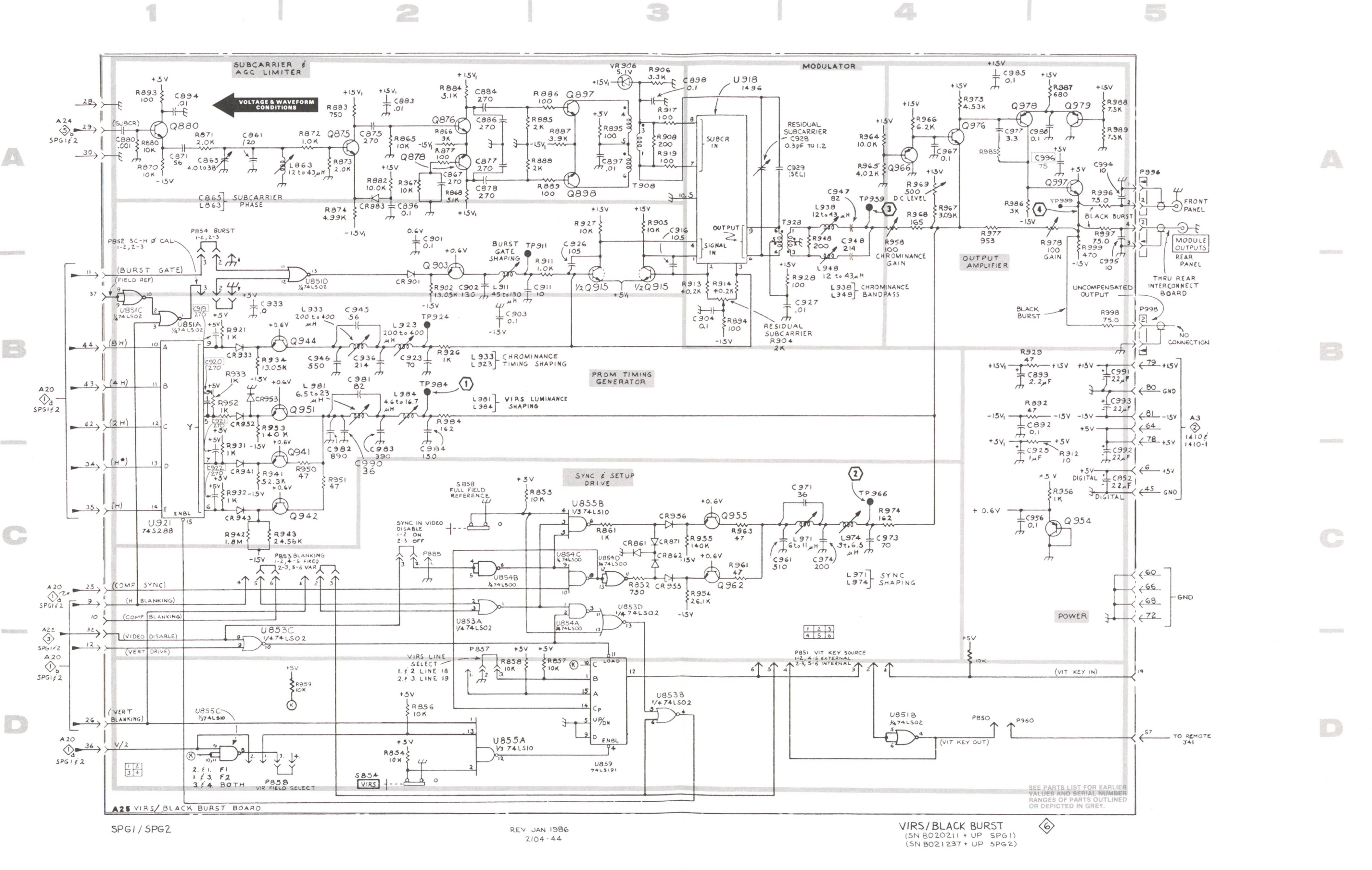
VIRS / BLACK BURST PARTS LOCATING CHART

C852	C5
C861	A1
C865	A1
C867	A2
C871	A1
C875	A2
C877	A2
C878	A2
C880	A1
C883	A2
C884	A2
C886	A2
C892	B5
C894	A1
C896	A2
C897	A3
C898	A3
C899	B5
C901	A2
C902	B2
C903	B2
C904	B3
C911	B3
C916	B3
C919*	B1
C920*	B1
C921*	B1
C922*	C1
C923	B2
C925	C5
C926	B3
C927	B4
C928	A3
C929	A4
C933	B1
C936	B2
C945	B2
C946	B2
C947	A4
C948	B4
C956	C4
C961	C4
C967	A4
C971	C4
C973	C4
C974	C4
C977	A4
C981	B2
C982	B2
C983	B2
C984	B2
C985	A4
C986	A5
C990	B2
C991	B5
C992	C5
C993	B5
C994	A5
C995	B5
C996	A5

CR861	C3
CR862	C3
CR871	C3
CR883	A2
CR901	B2
CR933	B1
CR941	C1
CR943	C1
CR952	B1
CR955	C3
CR956	C3
CR953	B1
L863	A2
L911	B2
L923	B2
L933	B2
L938	A4
L948	B4
L971	C4
L974	C4
L981	B2
L984	B2
P851	D3
P856	D4
P857	D1
P858	D2
P885	C2
P960	D4
P996	A5
Q875	A2
Q876	A2
Q878	A2
Q880	A1
Q897	A3
Q898	A3
Q903	B2
Q915	B3
Q941	C1
Q942	C2
Q944	B2
Q951	B2
Q954	C5
Q955	C3
Q962	C3
Q963	C3
Q966	A4
Q976	A4
Q978	A4
Q979	A5
Q997	A5

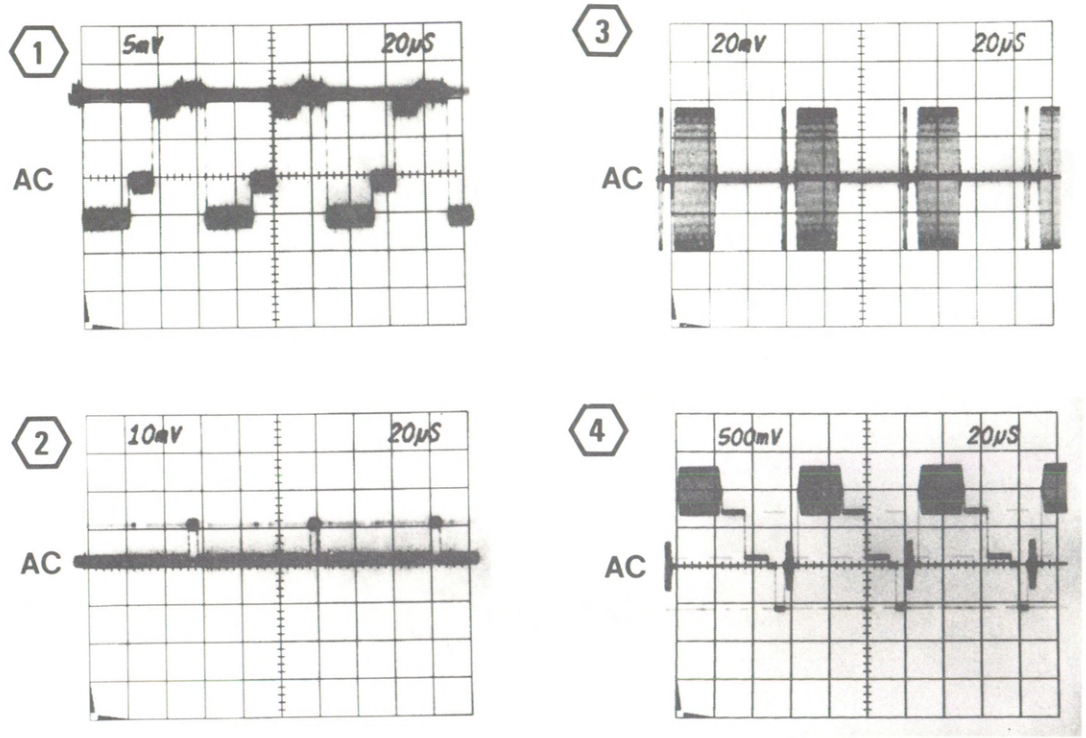
R852	C3
R854	D2
R855	C2
R856	D2
R587	D3
R858	D2
R859	D1
R861	C3
R865	A2
R866	A2
R867	A2
R868	A2
R870	A1
R871	A1
R872	A2
R873	A2
R874	A2
R877	A2
R880	A1
R882	A2
R883	A2
R884	A2
R885	A2
R886	A2
R887	A2
R888	A2
R889	A3
R892	B3
R893	A1
R894	B4
R895	A3
R902	B2
R904	B4
R905	A3
R906	A3
R908	A3
R911	B3
R912	C5
R913	B3
R914	B3
R917	A3
R919	A3
R921	B1
R926	B2
R927	A3
R928	B4
R929	B5
R931	C1
R932	C1
R933	B1
R934	B1
R941	C1
R942	C1
R943	C1
R948	A4
R950	C1
R951	C2
R952	B1
R953	B1

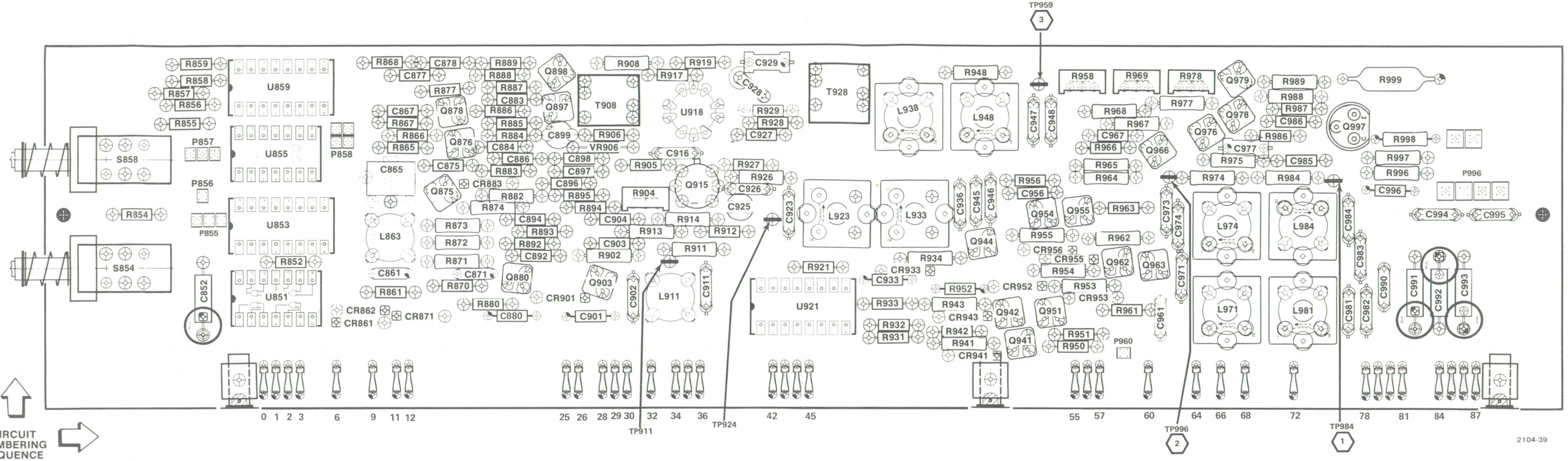
R954	C3
R955	C3
R956	C5
R958	A4
R960	C3
R961	C3
R962	C3
R963	C3
R964	A4
R965	A4
R966	A4
R967	A4
R968	A4
R969	A4
R974	C4
R975	A4
R977	A4
R978	A5
R984	B2
R985	A5
R986	A5
R987	A5
R988	A5
R989	A5
R996	A5
R997	A5
R998	B5
R999	B5
S854	D2
S858	C2
T908	A3
T928	A4
TP911	A3
TP924	B2
TP959	A4
TP966	C4
TP984	B2
TP999	A5
U851A	B3
U851B	D4
U851C	B1
U851D	B2
U853A	C2
U853B	D3
U853C	D1
U853D	C3
U853E	B2
U853F	D4
U855A	D3
U855B	C3
U855C	D1
U859	D3
U918	A3
U921	C1
VR906	A3



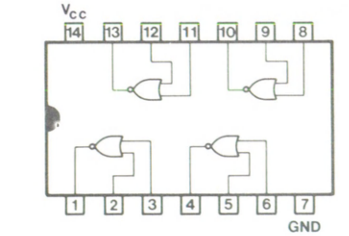
(SN B020211 & UP) SPG1
(SN B021237 & UP) SPG2

6

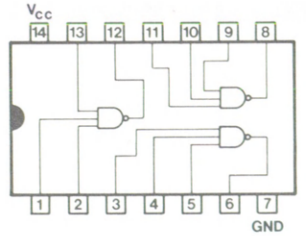




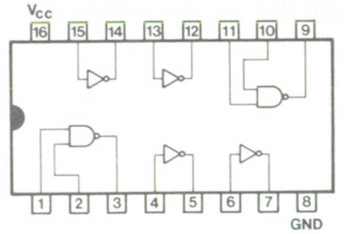
A25 VIRS / BLACK BURST CIRCUIT BOARD (SN B010127 - SN B020210) SPG1
(SN B010438 - SN B021236) SPG2



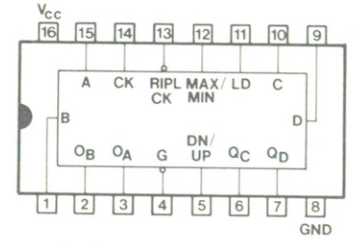
7402



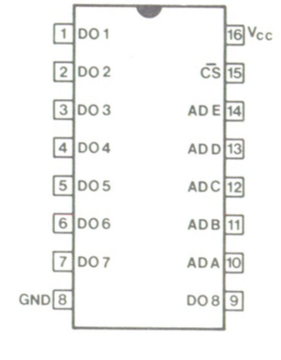
7410



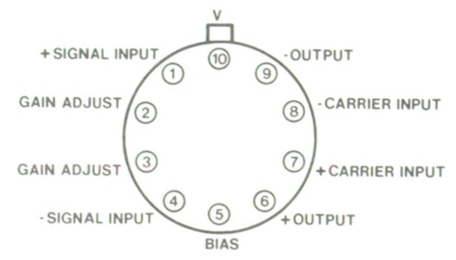
8090



74191



74288



MC1496Q

REV DEC 1985

2104-38

6

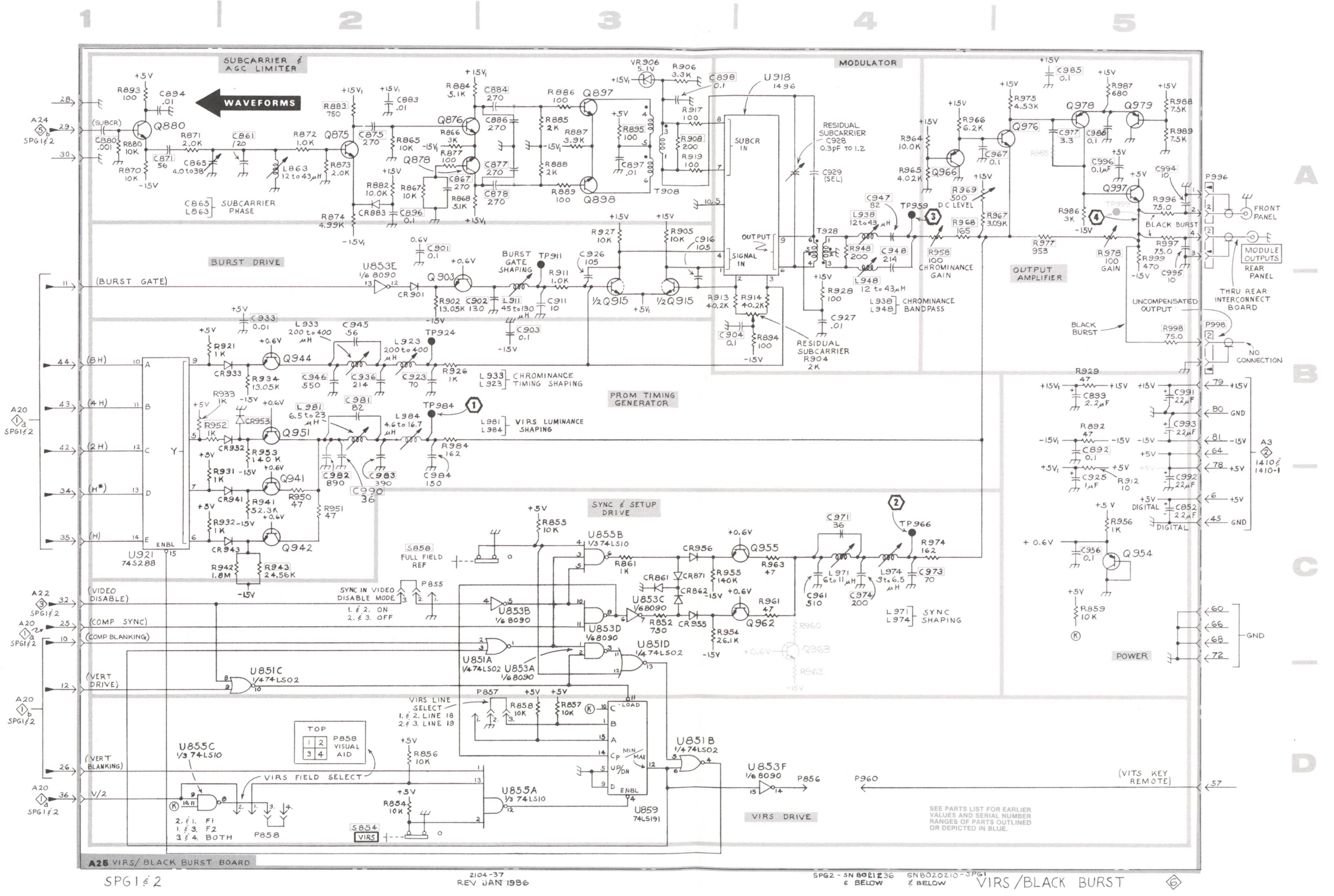
VIRS / BLACK BURST PARTS LOCATING CHART

C852	C5
C861	A2
C865	A1
C867	A2
C871	A1
C875	A2
C877	A3
C878	A3
C880	A1
C883	A2
C884	A3
C886	A3
C892	B5
C894	A1
C896	A2
C897	A3
C898	A3
C899	B5
C901	A2
C902	B3
C903	B3
C904	B4
C911	B3
C916	B3
C923	B2
C925	C5
C926	B3
C927	B4
C928	A4
C929	A4
C933	B2
C936	B2
C945	B2
C946	B2
C947	A4
C948	A4
C956	C5
C961	A4
C967	A4
C971	C4
C973	C4
C974	C4
C977	A5
C981	B2
C982	B2
C983	B2
C984	B2
C985	A5
C986	A5
C990	B2
C991	B5
C992	C5
C993	B5
C994	A5
C995	A5
C996	A5

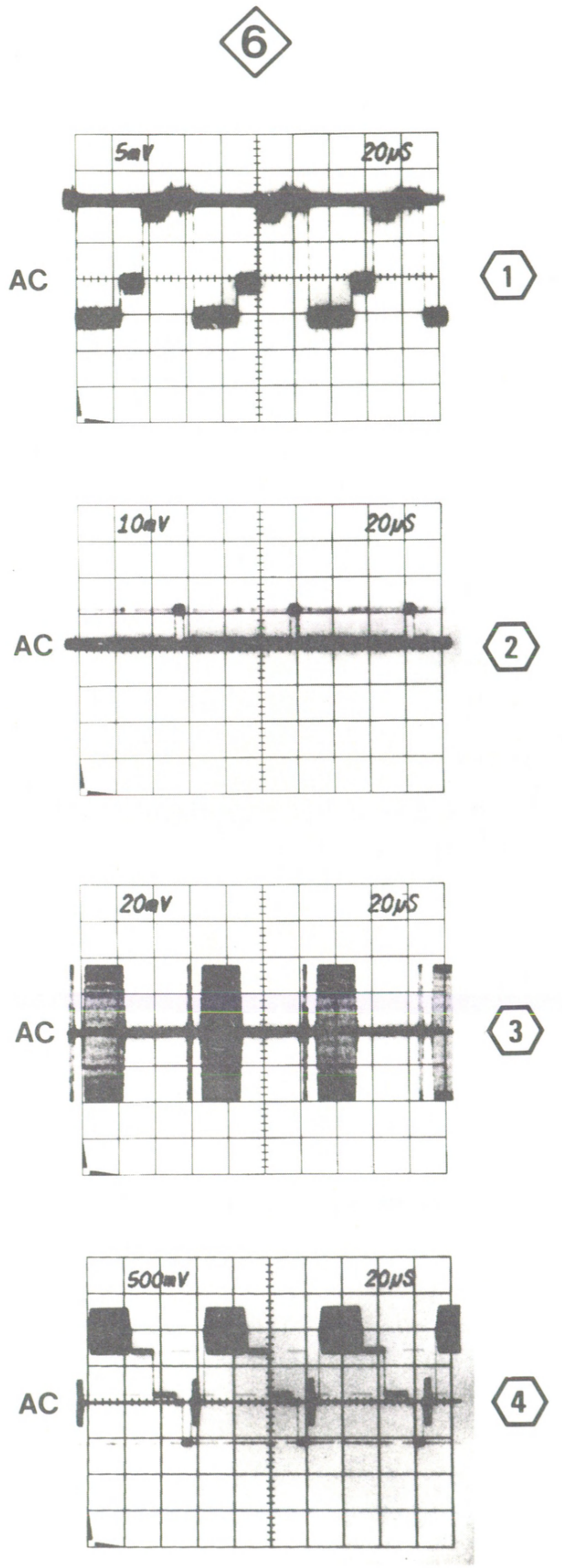
CR861	C3
CR862	C3
CR871	C3
CR883	A2
CR901	B2
CR933	B2
CR941	C2
CR943	C2
CR952	B2
CR955	C3
CR956	C3
CR953	B2
L863	A2
L911	B3
L923	B2
L933	B2
L938	A4
L948	A4
L971	C4
L974	C4
L981	B2
L984	B2
P856	D4
P857	D3
P858	D2
P885	C2
P960	D4
P996	A5
Q875	A2
Q876	A2
Q878	A2
Q880	A1
Q897	A3
Q898	A3
Q903	B2
Q915	B3
Q941	C2
Q942	C2
Q944	B2
Q951	B2
Q954	C5
Q955	C4
Q962	C4
Q963	D4
Q966	A4
Q976	A5
Q978	A5
Q979	A5
Q997	A5

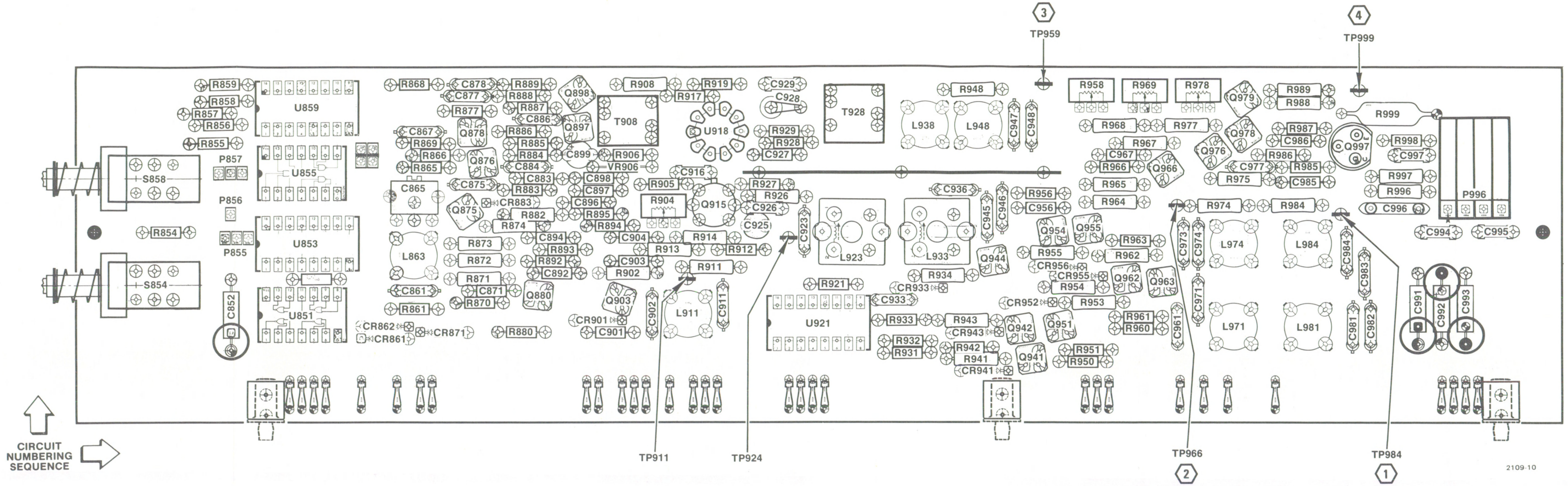
R852	C3
R854	D2
R855	C3
R856	D2
R587	D3
R858	D3
R859	C5
R861	C3
R865	A2
R866	A2
R867	A2
R868	A2
R870	A1
R871	A1
R872	A2
R873	A2
R874	A2
R877	A2
R880	A1
R882	A2
R883	A2
R884	A2
R885	A3
R886	A3
R887	A3
R888	A3
R889	A3
R892	B2
R893	A1
R894	B4
R895	A3
R902	B2
R904	B4
R905	A3
R906	A3
R908	A3
R911	B3
R912	C5
R913	B3
R914	B3
R917	A3
R919	A3
R921	B1
R926	B2
R927	A3
R928	B4
R929	B5
R931	C1
R932	C1
R933	B1
R934	B2
R941	C2
R942	C2
R943	C2
R948	A4
R950	B2
R951	C2
R952	B2
R953	B2

R954	C3
R955	C3
R956	C5
R958	A4
R960	C4
R961	C4
R962	D4
R963	C4
R964	A4
R965	A4
R966	A4
R967	A4
R968	A4
R969	A4
R974	C4
R975	A5
R977	A5
R978	A5
R984	B2
R985	A5
R986	A5
R987	A5
R988	A5
R989	A5
R996	A5
R997	A5
R998	B5
R999	A5
S854	C2
S858	D2
T908	A3
T928	A4
TP911	A3
TP924	B2
TP959	A4
TP966	C4
TP984	B2
TP999	A5
U851A	C3
U851B	D3
U851C	D2
U851D	C3
U853A	C3
U853B	C3
U853C	C3
U853D	C3
U853E	B2
U853F	D4
U855A	D3
U855B	C3
U855C	D1
U859	D3
U918	A4
U921	C1
VR906	A3

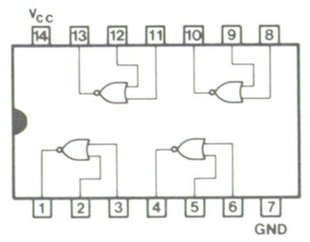


(SN B021236 & Below) SPG2

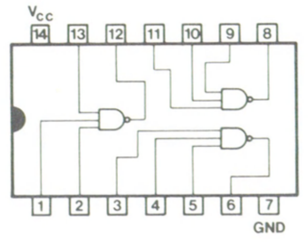




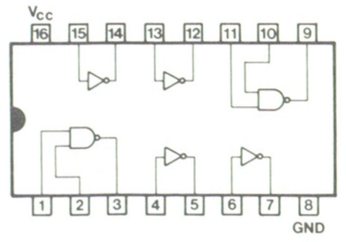
A25 VIRS / BLACK BURST CIRCUIT BOARD (SN B010100 - SN B010126) SPG1
(SN B010100 - SN B010437) SPG2



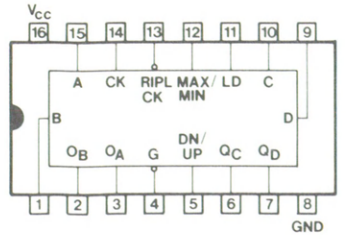
7402



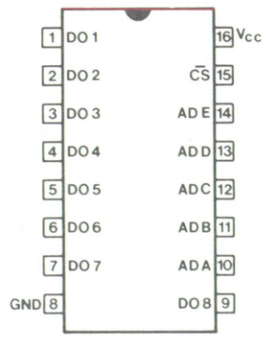
7410



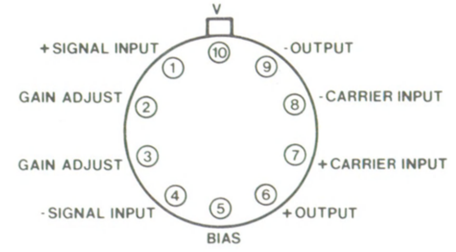
8090



74191



74288



MC1496G

2104-38

REV DEC 1985

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 *Name & Description*

Assembly and/or Component
Attaching parts for Assembly and/or Component
- - - * - - -
  Detail Part of Assembly and/or Component
  Attaching parts for Detail Part
- - - * - - -
    Parts of Detail Part
    Attaching parts for Parts of Detail Part
- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ABBREVIATIONS

	INCH	ELCTRN	ELECTRON	IN	INCH	SE	SINGLE END
#	NUMBER SIZE	ELEC	ELECTRICAL	INCAND	INCANDESCENT	SECT	SECTION
ACTR	ACTUATOR	ELCTLT	ELECTROLYTIC	INSUL	INSULATOR	SEMICOND	SEMICONDUCTOR
ADPTR	ADAPTER	ELEM	ELEMENT	INTL	INTERNAL	SHLD	SHIELD
ALIGN	ALIGNMENT	EPL	ELECTRICAL PARTS LIST	LPHLDR	LAMPHOLDER	SHLDR	SHOULDERED
AL	ALUMINUM	EQPT	EQUIPMENT	MACH	MACHINE	SKT	SOCKET
ASSEM	ASSEMBLED	EXT	EXTERNAL	MECH	MECHANICAL	SL	SLIDE
ASSY	ASSEMBLY	FIL	FILLISTER HEAD	MTG	MOUNTING	SLFLKG	SELF-LOCKING
ATTEN	ATTENUATOR	FLEX	FLEXIBLE	NIP	NIPPLE	SLVG	SLEEVING
AWG	AMERICAN WIRE GAGE	FLH	FLAT HEAD	NON WIRE	NOT WIRE WOUND	SPR	SPRING
BD	BOARD	FLTR	FILTER	OBD	ORDER BY DESCRIPTION	SQ	SQUARE
BRKT	BRACKET	FR	FRAME or FRONT	OD	OUTSIDE DIAMETER	SST	STAINLESS STEEL
BRS	BRASS	FSTNR	FASTENER	OVH	OVAL HEAD	STL	STEEL
BRZ	BRONZE	FT	FOOT	PH BRZ	PHOSPHOR BRONZE	SW	SWITCH
BSHG	BUSHING	FXD	FIXED	PL	PLAIN or PLATE	T	TUBE
CAB	CABINET	GSKT	GASKET	PLSTC	PLASTIC	TERM	TERMINAL
CAP	CAPACITOR	HDL	HANDLE	PN	PART NUMBER	THD	THREAD
CER	CERAMIC	HEX	HEXAGON	PNH	PAN HEAD	THK	THICK
CHAS	CHASSIS	HEX HD	HEXAGONAL HEAD	PWR	POWER	TNSN	TENSION
CKT	CIRCUIT	HEX SOC	HEXAGONAL SOCKET	RCPT	RECEPTACLE	TPG	TAPPING
COMP	COMPOSITION	HLCPS	HELICAL COMPRESSION	RES	RESISTOR	TRH	TRUSS HEAD
CONN	CONNECTOR	HLEXT	HELICAL EXTENSION	RGD	RIGID	V	VOLTAGE
COV	COVER	HV	HIGH VOLTAGE	RLF	RELIEF	VAR	VARIABLE
CPLG	COUPLING	IC	INTEGRATED CIRCUIT	RTNR	RETAINER	W/	WITH
CRT	CATHODE RAY TUBE	ID	INSIDE DIAMETER	SCH	SOCKET HEAD	WSHR	WASHER
DEG	DEGREE	IDENT	IDENTIFICATION	SCOPE	OSCILLOSCOPE	XFMR	TRANSFORMER
DWR	DRAWER	IMPLR	IMPELLER	SCR	SCREW	XSTR	TRANSISTOR

CROSS INDEX - MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
00779	AMP INC	P O BOX 3608	HARRISBURG PA 17105
05129	KILO ENGINEERING CO	2015 D	LA VERNE CA 91750
06383	PANDUIT CORP	17301 RIDGELAND	TINLEY PARK IL 60477
07707	USM CORP SUB OF EMHART INDUSTRIES INC USM FASTENER DIV	510 RIVER RD	SHELTON CT 06484
08261	SPECTRA-STRIP AN ELTRA CO	7100 LAMPSON AVE	GARDEN GROVE CA 92642
09922	BURNDY CORP	RICHARDS AVE	NORWALK CT 06852
12327	FREEWAY CORP	9301 ALLEN DR	CLEVELAND OH 44125
12515	TELEDYNE INC TELEDYNE THERMATICS	P O BOX 909	ELM CITY NC 27822
13511	AMPHENOL CADRE DIV BUNKER RAMO CORP		LOS GATOS CA
22526	DU PONT E I DE NEMOURS AND CO INC DU PONT CONNECTOR SYSTEMS	30 HUNTER LANE	CAMP HILL PA 17011
26365	GRIES REPRODUCER CO DIV OF COATS AND CLARK INC	125 BEECHWOOD AVE	NEW ROCHELLE NY 10802
27264	MOLEX INC CORPORATE HQ	2222 WELLINGTON COURT	LISLE IL 60532
32436	SYSCON INTERNATIONAL, INC.	205 SYCAMORE ST.	SOUTH BEND, IN 46622
50434	HEWLETT-PACKARD CO OPTOELECTRONICS DIV	640 PAGE MILL RD	PALO ALTO CA 94304
56375	WESCORP, DIV OF DAL INDUSTRIES, INC.	1155 TERRA BELLA AVE.	MT VIEW, CA 94043
58361	GENERAL INSTRUMENT CORP OPTOELECTRONICS DIV	3400 HILLVIEW AVE	PALO ALTO CA 94304
71590	GLOBE-UNION INC CENTRALAB ELECTRONICS DIV	HWY 20 W P O BOX 858	FORT DODGE IA 50501
71785	TRW INC TRW CINCH CONNECTORS	1501 MORSE AVE	ELK GROVE VILLAGE IL 60007
73743	FISCHER SPECIAL MFG CO	446 MORGAN ST	CINCINNATI OH 45206
74932	INDUSTRIAL SPECIALTIES, INC.		WARREN, MI 48091
76854	OAK SWITCH SYSTEMS INC SUB OF OAK TECHNOLOGY INC	100 S MAIN ST	CRYSTAL LAKE IL 60014
80009	TEKTRONIX INC	4900 S W GRIFFITH DR P O BOX 500	BEAVERTON OR 97077
81073	GRAYHILL INC	561 HILLGROVE AVE P O BOX 373	LA GRANGE IL 60525
83486	ELCO INDUSTRIES INC	1101 SAMUELSON RD	ROCKFORD IL 61101
93907	TEXTRON INC CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61101
TK1375	ESAM	PO BOX 376	GRANTS PASS OR 97526

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-1	131-0955-00			4	CONN,RCPT,ELEC:BNC,FEMALE	13511	31-279
					(ATTACHING PARTS)		
-2	210-0255-00			4	TERMINAL,LUG:0.391 ID,LOCKING,BRS CD PL	12327	ORDER BY DESCR
					(END ATTACHING PARTS)		
-3	119-0846-00			1	GONIOMETER,ELEC:3.58MHZ	80009	119-0846-00
					(ATTACHING PARTS)		
-4	331-0361-01			1	DIAL,CONTROL:SINGLE TURN W/LOCATING PIN	05129	572 S1
					(END ATTACHING PARTS)		
-5	260-0735-00			1	SWITCH,PUSH:T,NO CONTACT,RED BUTTON	81073	39-1
-6	366-1691-00			4	PUSH BUTTON:GY,1.2 L	80009	366-1691-00
-7	426-1206-00			4	FRAME,PUSH BTN:MOMENTARY,GRAY PLASTIC	80009	426-1206-00
-8	333-2174-00			1	PANEL,FRONT:GENERATOR	80009	333-2174-00
					(SPG1 ONLY)		
	333-2159-00			1	PANEL,FRONT:GENERAL	80009	333-2159-00
					(SPG2 ONLY)		
					(ATTACHING PARTS)		
-9	213-0120-00	B010100	B010283	4	SCREW,TPG,TF:2-32 X 0.25,TYPE B,PNH,STL	83486	234-004-202025
	213-0277-00	B010284		2	SCREW,TPG,TF:2-56 X 0.312,SPCL TYPE,PNH,STL	93907	234-01725-024
					(END ATTACHING PARTS)		
-10	----- -----			1	CKT BOARD ASSY:LED(SEE A27 REPL)		
					(ATTACHING PARTS)		
-11	210-0406-00			2	NUT,PLAIN,HEX:4-40 X 0.188,BRS CD PL	73743	12161-50
-12	361-0552-00			2	SPACER,SLEEVE:0.093 L X 0.126 ID,BRS	76854	3-5116-312
					(END ATTACHING PARTS)		
					CKT BOARD ASSY INCLUDES:		
-13	150-1029-00			2	.LT EMITTING DIO:GREEN,565NM,35MA	58361	Q6480/MV5274C
-14	150-1033-00			2	.LT EMITTING DIO:AMBER,585NM,40MA MAX	50434	HLMP 1401
-15	131-0608-00			6	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-16	----- -----			1	CKT BOARD ASSY:VIRS/BLACK BURST		
					(SEE A25 REPL)		
-17	131-0589-00	B010100	B020210	6	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
					.(SPG1 ONLY)		
	131-0589-00	B020211		5	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
					.(SPG1 ONLY)		
	131-0589-00	B010100	B021236	6	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
					.(SPG2 ONLY)		
	131-0589-00	B021237		5	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
					.(SPG2 ONLY)		
-18	131-0608-00	B010100	B020210	10	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
					.(SPG1 ONLY)		
	131-0608-00	B020211		29	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
					.(SPG1 ONLY)		
	131-0608-00	B010100	B021236	10	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
					.(SPG2 ONLY)		
	131-0608-00	B021237		29	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
					.(SPG2 ONLY)		
-19	131-0993-00	B010100	B020210	3	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
					.(SPG1 ONLY)		
	131-0993-00	B020211		5	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
					.(SPG1 ONLY)		
	131-0993-00	B010100	B021236	3	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
					.(SPG2 ONLY)		
	131-0993-00	B021237		5	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
					.(SPG2 ONLY)		
-20	136-0183-00	B010100	B020192	1	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT	80009	136-0183-00
					.(SPG1 ONLY)		
	136-0183-00	B010100	B020991	1	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT	80009	136-0183-00
					.(SPG2 ONLY)		
-21	136-0220-00	B010100	B020192	19	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-23-11-034
					.(SPG1 ONLY)		
	136-0220-00	B020193		1	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-23-11-034
					.(SPG1 ONLY)		
	136-0220-00	B010100	B020991	19	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-23-11-034
					.(SPG2 ONLY)		
	136-0220-00	B020992		1	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-23-11-034
					.(SPG2 ONLY)		
-22	136-0235-00			1	.SKT,PL-IN ELEK:TRANSISTOR,6 CONTACT	71785	133-96-12-062

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-23	136-0241-00	B010100	B020291	1	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT .(SPG1 ONLY)	71785	133-99-12-064
	136-0241-00	B010100	B021841	1	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT .(SPG2 ONLY)	71785	133-99-12-064
-24	136-0260-02	B010100	B020210	3	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B020211		2	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B010100	B021236	3	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
	136-0260-02	B021237		2	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
-25	136-0269-02	B010100	B020210	2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B020211		4	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B010100	B021236	2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
	136-0269-02	B021237		4	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
-26	136-0328-03	B010100	B020210	32	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG1 ONLY)	22526	47710
	136-0328-03	B020211		35	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG1 ONLY)	22526	47710
	136-0328-03	B010100	B021236	32	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG2 ONLY)	22526	47710
	136-0328-03	B021237		35	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG2 ONLY)	22526	47710
-27	214-0579-00			6	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-28	214-2440-00			3	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
-29	----- -----			2	.SWITCH,PUSH:(SEE S854,S858 REPL)		
-30	361-0542-00			4	.SPACER,PUSH SW:0.078 L,POLYPROPYLENE	71590	PCS-078
-31	337-1456-00	B010100	B010482	1	.SHIELD,ELEC:CKT BD MOUNT .(SPG1 ONLY)	80009	337-1456-00
	337-1456-00	B010100	B010126	1	.SHIELD,ELEC:CKT BD MOUNT .(SPG2 ONLY)	80009	337-1456-00
-32	337-1417-00			2	.SHIELD,ELEC:0.55 SQ X 0.685 INCH HIGH	32436	A-1020002-1
-33	----- -----	B010100	B010164	3	CKT BOARD ASSY:SHIELD(SEE A100 REPL) (SPG1 ONLY) CKT BOARD ASSY:SHIELD(SEE A100 REPL) (SPG1 ONLY) CKT BOARD ASSY:SHIELD(SEE A100 REPL) (SPG2 ONLY) CKT BOARD ASSY:SHIELD(SEE A100 REPL) (SPG2 ONLY)		
-34	136-0328-03	B010100	B010164	12	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG1 ONLY)	22526	47710
	136-0328-03	B010165		8	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG1 ONLY)	22526	47710
	136-0328-03	B010100	B010849	12	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG2 ONLY)	22526	47710
	136-0328-03	B010850		8	.SOCKET,PIN TERM:U/W 0.025 SQ PINS .(SPG2 ONLY)	22526	47710
	198-2868-00	B020211		2	.WIRE SET,ELEC: .(SPG1 ONLY)	80009	198-2868-00
	198-2868-00	B021237		2	.WIRE SET,ELEC: .(SPG2 ONLY)	80009	198-2868-00
	131-0707-00	B020211		4	..CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL ..(SPG1 ONLY)	22526	47439-000
	131-0707-00	B021237		4	..CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL ..(SPG2 ONLY)	22526	47439-000
	175-0733-00	B020211		AR	..WIRE,ELECTRICAL:STRD,26 AWG,150V RMS,BLAC ..K,PVC ..(SPG1 ONLY)	12515	ORDER BY DESCR
	175-0733-00	B021237		AR	..WIRE,ELECTRICAL:STRD,26 AWG,150V RMS,BLAC ..K,PVC ..(SPG2 ONLY)	12515	ORDER BY DESCR

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	352-0177-00	B020211		1	..HLDR,TERM CONN:6 WIRE,DBL ROW BLACK ..(SPG1 ONLY)	80009	352-0177-00
	352-0177-00	B021237		1	..HLDR,TERM CONN:6 WIRE,DBL ROW BLACK ..(SPG2 ONLY)	80009	352-0177-00
-35	----- -----			1	CKT BOARD ASSY:SUBCARRIER LOCK (SEE A23 REPL ONLY)		
-36	131-0608-00			13	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-37	131-0993-00			3	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
-38	136-0220-00	B010100	B020991	31	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-23-11-034
	136-0220-00	B020992		5	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT	71785	133-99-11-034
-39	136-0241-00	B010100	B021841	3	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT	71785	133-99-12-064
-40	136-0260-02			1	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL	09922	DILB16P-108T
-41	136-0269-02			1	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-42	136-0328-03			16	.SOCKET,PIN TERM:U/W 0.025 SQ PINS	22526	47710
-43	136-0514-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-44	214-0579-00			12	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-45	214-2440-00			2	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
-46	337-1417-00			1	.SHIELD,ELEC:0.55 SQ X 0.685 INCH HIGH	32436	A-1020002-1
-47	----- -----			1	CKT BOARD ASSY:SYNC TIMING(SEE A20 REPL)		
-48	006-2358-00	B010100	B020220	1	.FOAM,CONDUCTIVE:0.75 X 2 X 2.25 .(SPG1 ONLY)	56375	ORDER BY DESCR
	006-2358-00	B010100	B021321	1	.FOAM,CONDUCTIVE:0.75 X 2 X 2.25 .(SPG2 ONLY)	56375	ORDER BY DESCR
-49	131-0608-00	B010100	B010136	24	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG1 ONLY)	22526	48283-036
	131-0608-00	B010137	B020219	29	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG1 ONLY)	22526	48283-036
	131-0608-00	B020220		30	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG1 ONLY)	22526	48283-036
-50	131-0993-00	B010100	B010137	8	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
-51	136-0220-00	B010100	B020192	9	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG1 ONLY)	71785	133-23-11-034
	136-0220-00	B020193		4	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG1 ONLY)	71785	133-23-11-034
	136-0220-00	B010100	B020991	9	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG2 ONLY)	71785	133-23-11-034
	136-0220-00	B020992		4	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG2 ONLY)	71785	133-23-11-034
-52	136-0260-02	B010100	B020219	12	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B020200		13	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B010100	B021321	12	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
	136-0260-02	B021322		13	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
-53	136-0269-02	B010100	B020219	18	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B020220	B020291	19	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B020292		15	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B010100	B021321	18	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
	136-0269-02	B021322	B021841	19	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
	136-0269-02	B021842		15	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
-54	136-0328-03			45	.SOCKET,PIN TERM:U/W 0.025 SQ PINS	22526	47710
-55	136-0641-00	B010100	B010132	1	.SKT,PL-IN ELEK:MICROCIRCUIT,40 DIP .(SPG1 ONLY)	00779	1-485169-2
	136-0623-00	B010133		1	.SKT,PL-IN ELEK:CMPNT,40 DIP,LOW PROFILE .(SPG1 ONLY)	09922	DILB40P-108
	136-0641-00	B010100	B010519	1	.SKT,PL-IN ELEK:MICROCIRCUIT,40 DIP .(SPG2 ONLY)	00779	1-485169-2
	136-0623-00	B010520		1	.SKT,PL-IN ELEK:CMPNT,40 DIP,LOW PROFILE .(SPG2 ONLY)	09922	DILB40P-108

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-56	214-0579-00	B010100	B020219	1	.TERM,TEST POINT:BRS CD PL .(SPG1 ONLY)	80009	214-0579-00
	214-0579-02	B020220		3	.TERM,TEST POINT:BRASS .(SPG1 ONLY)	80009	214-0579-02
	214-0579-00	B010100	B021321	1	.TERM,TEST POINT:BRS CD PL .(SPG2 ONLY)	80009	214-0579-00
	214-0579-02	B021322		3	.TERM,TEST POINT:BRASS .(SPG2 ONLY)	80009	214-0579-02
-57	214-2440-00			2	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
-58	----- -----			1	.SWITCH,PUSH:(SEE S109 REPL)		
-59	346-0130-00			1	.STRAP,RETAINING:U/W 40 CONT MICROCKT	00779	350894-1
	385-0109-00	B023201		1	SPACER,POST:0.312 L W/4-40 THD THRU,NYL (ATTACHING PARTS)	80009	385-0109-00
	211-0040-00	B023201		1	SCREW,MACHINE:4-40 X 0.25,BDGH,NYL (END ATTACHING PARTS)	26365	ORDER BY DESCR
-60	----- -----			1	CKT BOARD ASSY:GENERATOR LOGIC (SEE A22 REPL)		
-61	131-0589-00	B010100	B010136	9	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
	131-0608-00	B010137		10	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-62	131-0608-00	B010100	B010136	25	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
	131-0608-00	B010137		26	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
-63	131-0993-00			8	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
-64	136-0252-07			18	.SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-65	136-0260-02			5	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL	09922	DILB16P-108T
-66	136-0269-02			8	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-67	136-0328-03			28	.SOCKET,PIN TERM:U/W 0.025 SQ PINS	22526	47710
-68	214-2440-00			3	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
-69	214-0579-00			3	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-70	263-0010-00			3	.SWITCH PB ASSY:1 PUSH,7.5 MM,W/2 CONTACTS	80009	263-0010-00
-71	343-0495-05			1	.CLIP,SWITCH:FRONT,7.5MM X 5 UNIT	80009	343-0495-05
	348-0430-00	B010103		2	.BUMPER,PLASTIC:BLACK POLYURETHANE .(SPG1 ONLY)	74932	SJ5027
	348-0430-00	B010139		2	.BUMPER,PLASTIC:BLACK POLYURETHANE .(SPG2 ONLY) .(ATTACHING PARTS)	74932	SJ5027
-72	210-3033-00			3	.EYELET,METALLIC:0.059 OD X 0.156 L,BRS .(END ATTACHING PARTS)	07707	SE-25
-73	343-0499-05	B010100	B012137	1	.CLIP,SWITCH:REAR,7.5MM X 5 UNIT .(SPG1 ONLY)	80009	343-0499-05
	343-0499-14	B012138		1	.CLIP,SWITCH:7.5MM X 5 UNIT .(SPG1 ONLY)	80009	343-0499-14
	343-0499-05	B010100	B012140	1	.CLIP,SWITCH:REAR,7.5MM X 5 UNIT .(SPG2 ONLY)	80009	343-0499-05
	343-0499-14	B012141		1	.CLIP,SWITCH:7.5MM X 5 UNIT .(SPG2 ONLY) .(ATTACHING PARTS)	80009	343-0499-14
-74	210-3033-00			3	.EYELET,METALLIC:0.059 OD X 0.156 L,BRS .(END ATTACHING PARTS)	07707	SE-25
-75	----- -----			1	CKT BOARD ASSY:SYNC LOCK(SEE A21 REPL)		
-76	131-0608-00			10	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG1 ONLY)	22526	48283-036
	131-0589-00	B030000		AR	TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
	131-0589-00			6	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ .(SPG1 ONLY)	22526	48283-029
	131-0608-00	B010100	B010175	8	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG2 ONLY)	22526	48283-036
	131-0608-00	B010176	B029999	2	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG2 ONLY)	22526	48283-036
	131-0608-00	B030000		13	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL .(SPG2 ONLY)	22526	48283-036
	131-0589-00	B010176	B029999	6	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ .(SPG2 ONLY)	22526	48283-029
	131-0589-00	B030000		7	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ .(SPG2 ONLY)	22526	48283-029
-77	131-0993-00	B010100	B010136	2	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
	131-0993-00	B010137		3	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
-78	136-0241-00	B010100	B012485	1	.SKT,PL-IN ELEK:MICROCIRCUIT,10 CONT	71785	133-99-12-064

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-79	136-0252-07			42	.SOCKET,PIN CONN:W/O DIMPLE .(SPG1 ONLY)	22526	75060-012
	136-0252-07	B010100	B029999	42	.SOCKET,PIN CONN:W/O DIMPLE .(SPG2 ONLY)	22526	75060-012
-80	136-0260-02	B010100	B020291	9	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B020292		6	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG1 ONLY)	09922	DILB16P-108T
	136-0260-02	B010100	B021841	9	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
	136-0260-02	B021842	B029999	6	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL .(SPG2 ONLY)	09922	DILB16P-108T
-81	136-0269-02			11	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG1 ONLY)	09922	DILB14P-108T
	136-0269-02	B010100	B029999	11	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP .(SPG2 ONLY)	09922	DILB14P-108T
-82	136-0328-03			24	.SOCKET,PIN TERM:U/W 0.025 SQ PINS	22526	47710
-83	136-0514-00			2	.SKT,PL-IN ELEK:MICROCIRCUIT,8 DIP .(SPG1 ONLY)	09922	DILB8P-108
	136-0514-00	B010100	B029999	2	.SKT,PL-IN ELEK:MICROCIRCUIT,8 DIP .(SPG2 ONLY)	09922	DILB8P-108
-84	214-0579-00			14	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-85	214-2440-00			3	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
-86	----- -----			1	CKT BOARD ASSY:PULSE OUTPUT AMPL (SEE A24 REPL)		
-87	376-0029-00	B010100	B010132	1	.CPLG,SHAFT,RGD:0.128 ID X 0.312 OD,AL .(SPG1 ONLY)	80009	376-0029-00
	376-0051-00	B010133		1	.CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD .(SPG1 ONLY)	80009	376-0051-00
	376-0029-00	B010100	B010849	1	.CPLG,SHAFT,RGD:0.128 ID X 0.312 OD,AL .(SPG2 ONLY)	80009	376-0029-00
	376-0051-00	B010850		1	.CPLG,SHAFT,FLEX:0.127 ID X 0.375 OD .(SPG2 ONLY)	80009	376-0051-00
-88	384-1171-00			1	.EXTENSION SHAFT:1.05 L X 0.125 OD,AL	80009	384-1171-00
-89	131-0589-00			11	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
-90	131-0608-00	B010100	B012529	13	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
	131-0608-00	B012530		11	.TERMINAL,PIN:0.365 L X 0.025 BRZ GLD PL	22526	48283-036
	131-0589-00	B012530		4	.TERMINAL,PIN:0.46 L X 0.025 SQ PH BRZ	22526	48283-029
-91	131-0787-00			24	.TERMINAL,PIN:0.64 L X 0.025 SQ PH BRZ	22526	47359-000
-92	131-0993-00			1	.BUS,CONDUCTOR:SHUNT ASSEMBLY,BLACK	22526	65474-005
-93	136-0183-00	B010100	B020192	1	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT .(SPG1 ONLY)	80009	136-0183-00
	136-0183-00	B010100	B020991	1	.SKT,PL-IN ELEK:TRANSISTOR,3 CONTACT .(SPG2 ONLY)	80009	136-0183-00
-94	136-0220-00	B010100	B020192	5	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG1 ONLY)	71785	133-23-11-034
	136-0220-00	B010100	B020991	5	.SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT .(SPG2 ONLY)	71785	133-23-11-034
-95	136-0260-02			7	.SKT,PL-IN ELEK:MICROCKT,16 DIP,LOW CL	09922	DILB16P-108T
-96	136-0269-02			4	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP	09922	DILB14P-108T
-97	136-0328-03			28	.SOCKET,PIN TERM:U/W 0.025 SQ PINS	22526	47710
-98	136-0514-00			1	.SKT,PL-IN ELEK:MICROCIRCUIT,8 DIP	09922	DILB8P-108
-99	214-2440-00			3	.RECEPTACLE,PIN:CIRCUIT BOARD	80009	214-2440-00
	198-3291-00	B010100	B010146	1	WIRE SET,ELEC: (SPG1 ONLY)	80009	198-3291-00
	198-3291-00	B010100	B010699	1	WIRE SET,ELEC: (SPG2 ONLY)	80009	198-3291-00
-100	175-0829-00	B010100	B010146	AR	.CABLE,SP,ELEC:6,26 AWG,STRD,PVC JKT,RBN .(SPG1 ONLY)	08261	111-2699-973
	175-0829-00	B010100	B010699	AR	.CABLE,SP,ELEC:6,26 AWG,STRD,PVC JKT,RBN .(SPG2 ONLY)	08261	111-2699-973
-101	352-0164-00	B010100	B010146	2	.HLDR,TERM CONN:6 WIRE,BLACK .(SPG1 ONLY)	80009	352-0164-00
	352-0164-00	B010100	B010699	2	.HLDR,TERM CONN:6 WIRE,BLACK .(SPG2 ONLY)	80009	352-0164-00
-102	131-0707-00	B010100	B010146	12	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL .(SPG1 ONLY)	22526	47439-000

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	131-0707-00	B010100	B010699	1	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL .(SPG2 ONLY)	22526	47439-000
-103	352-0198-01	B010100	B010146	1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG1 ONLY)	80009	352-0198-01
	352-0198-01	B010100	B010699	1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG2 ONLY)	80009	352-0198-01
	131-0622-00	B010100	B010146	1	.CONTACT,ELEC:28-32 AWG,BRS & CU BE GLD PL .(SPG1 ONLY)	22526	46241-000
	131-0622-00	B010100	B010699	1	.CONTACT,ELEC:28-32 AWG,BRS & CU BE GLD PL .(SPG2 ONLY)	22526	46241-000
	131-0621-00	B010100	B010146	1	.CONN,TERM:22-26 AWG,BRS,CU BE GLD PL .(SPG1 ONLY)	22526	46231-000
	131-0621-00	B010100	B010699	1	.CONN,TERM:22-26 AWG,BRS,CU BE GLD PL .(SPG2 ONLY)	22526	46231-000
-104	352-0162-01	B010100	B010146	1	.HLDR,TERM CONN:4 WIRE,BROWN .(SPG1 ONLY)	80009	352-0162-01
	352-0162-01	B010100	B010699	1	.HLDR,TERM CONN:4 WIRE,BROWN .(SPG2 ONLY)	80009	352-0162-01
	131-0708-00	B010100	B010146	2	.CONTACT,ELEC:28-32 AWG,BRS,CU BE GLD PL .(SPG1 ONLY)	22526	47437-000
	131-0708-00	B010100	B010699	2	.CONTACT,ELEC:28-32 AWG,BRS,CU BE GLD PL .(SPG2 ONLY)	22526	47437-000
	131-0707-00	B010100	B010146	2	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL .(SPG1 ONLY)	22526	47439-000
	131-0707-00	B010100	B010699	2	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL .(SPG2 ONLY)	22526	47439-000
	175-3026-00	B010147		1	CA ASSY,SP,ELEC:6,26 AWG,6.25 L (SPG1 ONLY)	80009	175-3026-00
	175-3026-00	B010700		1	CA ASSY,SP,ELEC:6,26 AWG,6.25 L (SPG2 ONLY)	80009	175-3026-00
	352-0164-05	B010147		2	.HLDR,TERM CONN:6 WIRE,GREEN .(SPG1 ONLY)	80009	352-0164-05
	352-0164-05	B010700		2	.HLDR,TERM CONN:6 WIRE,GREEN .(SPG2 ONLY)	80009	352-0164-05
	175-3027-00	B010147		1	CABLE ASSY,RF:50 OHM COAX,6.0 L,9-8 (SPG1 ONLY)	TK1375	ORDER BY DESCR
	175-3027-00	B010700		1	CABLE ASSY,RF:50 OHM COAX,6.0 L,9-8 (SPG2 ONLY)	TK1375	ORDER BY DESCR
	352-0169-01	B010147		1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG1 ONLY)	80009	352-0169-01
	352-0169-01	B010700		1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG2 ONLY)	80009	352-0169-01
	352-0169-04	B010147		1	.HLDR,TERM CONN:2 WIRE,YELLOW .(SPG1 ONLY)	80009	352-0169-04
	352-0169-04	B010700		1	.HLDR,TERM CONN:2 WIRE,YELLOW .(SPG2 ONLY)	80009	352-0169-04
	175-3029-00	B010147		1	CABLE ASSY,RF:75 OHM COAX,15.5 L,9-0 (SPG1 ONLY)	TK1375	ORDER BY DESCR
	175-3029-00	B010700		1	CABLE ASSY,RF:75 OHM COAX,15.5 L,9-0 (SPG2 ONLY)	TK1375	ORDER BY DESCR
	352-0198-01	B010147		1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG1 ONLY)	80009	352-0198-01
	352-0198-01	B010700		1	.HLDR,TERM CONN:2 WIRE,BROWN .(SPG2 ONLY)	80009	352-0198-01
	198-3290-00			1	WIRE SET,ELEC: (SPG2 ONLY)	TK1375	ORDER BY DESCR
-105	352-0169-00			1	.HLDR,TERM CONN:2 WIRE,BLACK	80009	352-0169-00
	352-0169-05			1	.HLDR,TERM CONN:2 WIRE,GREEN	80009	352-0169-05
	131-0708-00			2	.CONTACT,ELEC:28-32 AWG,BRS,CU BE GLD PL	22526	47437-000
	131-0707-00			2	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL	22526	47439-000
	179-2469-00	B010100	B023440	1	WIRING HARNESS:PULSE OUTPUT COAX	80009	179-2469-00
	179-2469-01	B023440		1	WIRING HARNESS:PULSE OUTPUT COAX	TK1375	ORDER BY DESCR
	175-9821-00	B023440		1	CA ASSY,SP,ELEC:3,26 AWG,6.75 L	TK1375	ORDER BY DESCR
	343-0549-00			6	.STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
	131-0707-00	B010100	B023439	30	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL	22526	47439-000
	131-1815-00	B023440		30	.CONTACT,ELEC:FEMALE CONNECTOR	27264	08-56-0110
	131-0708-00			24	.CONTACT,ELEC:28-32 AWG,BRS,CU BE GLD PL	22526	47437-000

Fig. & Index No.	Tektronix Part No.	Serial/Assembly No. Effective	Dscont	Qty	12345 Name & Description	Mfr. Code	Mfr. Part No.
1-	131-2428-00			24	.CONTACT,ELEC:18-20 AWG,BRS,CU BE,GLD PL	22526	47441-000
-106	352-0161-01	B010100	B023439	2	.HLDR,TERM CONN:3 WIRE,BROWN	80009	352-0161-01
	204-0678-00	B023440		2	.CONN BODY,PLUG:3 FEMALE CONTACTS	27264	10-17-2032
	352-0164-00			8	.HLDR,TERM CONN:6 WIRE,BLACK	80009	352-0164-00
	179-2471-01	B010100	B020338	1	WIRING HARNESS:SPG1 & 2 COAX (SPG1 ONLY)	80009	179-2471-01
	179-2471-02	B020339		1	WIRING HARNESS:SPG1 &2 COAX (SPG1 ONLY)	TK1375	ORDER BY DESCR
	179-2471-01	B010100	B022516	1	WIRING HARNESS:SPG1 & 2 COAX (SPG2 ONLY)	80009	179-2471-01
	179-2471-02	B022517		1	WIRING HARNESS:SPG1 &2 COAX (SPG2 ONLY)	TK1375	ORDER BY DESCR
	343-0549-00			9	.STRAP,TIEDOWN,E:0.091 W X 4.0 L,ZYTEL	06383	PLT1M
	131-0707-00			9	.CONTACT,ELEC:22-26 AWG,BRS,CU BE GLD PL	22526	47439-000
	131-0708-00			9	.CONTACT,ELEC:28-32 AWG,BRS,CU BE GLD PL	22526	47437-000
	131-2428-00			9	.CONTACT,ELEC:18-20 AWG,BRS,CU BE,GLD PL	22526	47441-000
-107	352-0166-00			1	.HLDR,TERM CONN:8 WIRE,BLACK	80009	352-0166-00
	352-0166-07			1	.HLDR,TERM CONN:8 WIRE,VIOLET	80009	352-0166-07
	352-0162-07			1	.HLDR,TERM CONN:4 WIRE,VIOLET	80009	352-0162-07
					.		
					STANDARD ACCESSORIES		
	070-2104-00			1	MANUAL,TECH:INSTR	80009	070-2104-00

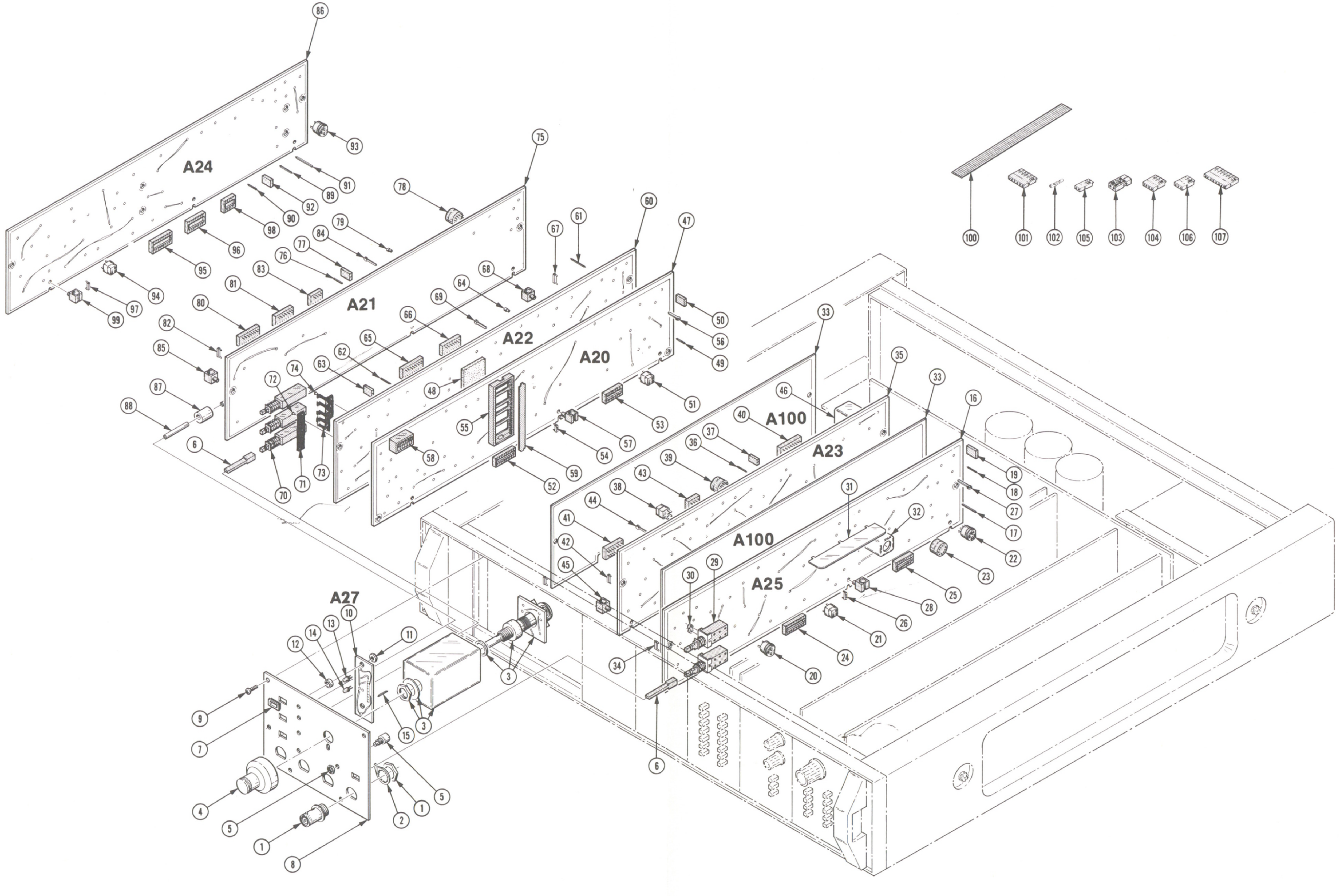

A24
A21
A22
A20
A100
A23
A100
A25
A27

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
	070-2104-00			1	MANUAL,TECH:INSTRUCTION	80009	070-2104-00

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

Tektronix
COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION Group Code 20

Date: 4/28/86 Change Reference: M58637 Rev 1

Product: SPG2 Manual Part No: 070-2104-00

DESCRIPTION

SPG2A

The SPG2A is a modified Sync Generator module for the 1410 Generator. The purpose of this modification is to ensure that SCH Phasing will remain in compliance with RS170A throughout the Horiz Delay range.

The Horiz Delay circuit, consisting of U200A, R202, R175, and C202, has been removed from its location in the Sync Subcarrier Lock circuitry (shown on schematic 2b). U325–5 now receives its input directly from Interface line 3.

New circuitry has been added, in line at the horizontal reference input, to the Sync Phase Comparator circuitry (shown on schematic 2a), to handle the HORIZ DELAY function. See the partial schematic 2a included with this insert.

Essentially, this added circuitry delays the application of the horizontal reference pulse, from Interface line 87, to the Sync Phase Comparator circuitry.

When the horizontal reference pulse is received at Interface line 87, its rising edge triggers U198B, a one–shot. U198B effects the delay of the horizontal reference pulse. U198B's timing is affected by the HORIZ DELAY control, which varies the timing current; and by U197, which turns the timing current off for a length of time controlled by S200.

After U198B times out it triggers U200A, another one–shot. U200A generates the delayed horizontal reference pulse, and applies it to the Sync Phase Comparator.

Due to the impact of this change, the following information is being provided to cover the changes in the circuitry and procedures.

TEXT, PARTS LIST, and SCHEMATIC CHANGES

CHANGE Manual part number **TO:** 070-2104-01.

DELETE all references to SPG1, and **CHANGE** all references to SPG2 **TO READ:** SPG2A.

Page 1-2

SECTION 1 OPERATING INSTRUCTIONS, FRONT PANEL CONTROLS, Item 5.

CHANGE Item 5 **TO READ:**

5 HORIZ DELAY - Delays sync ± 1 μs with respect to incoming Sync Reference. A wider range can be selected, via S200 (Incremental H Delay) on the A21 SYNC LOCK board. In SYNC LOCK mode the delay is continuous, independent of subcarrier phase. In SUBCARRIER LOCK mode the delay is held to discrete values which are dependent on subcarrier phase. In INTERNAL mode this control has no effect. See system timing instructions for details.

Page 1-3

PRECEDING PERFORMANCE CHECK, **ADD** SYSTEM TIMING **AS FOLLOWS:**

SYSTEM TIMING

There are three controls provided for timing the SPG2A into your system, in GEN LOCK or EXTERNAL modes:

1. Front panel SUBCARRIER PHASE control (360°).
2. Front panel HORIZ DELAY control (± 1 μs).
3. Internal Incremental H Delay switch, S200 on the A21 SYNC LOCK board (+4, -10 μs, in 3 subcarrier-cycle increments).

Timing the SPG2A To Your System

1. Lock the SPG2A to its reference source.

2. Adjust the Incremental H Delay switch, S200 on the A21 SYNC LOCK board, to place the SPG2A BLACK BURST sync leading edge to within 1 μs of that of the system you are matching.

3. Determine the phase of the BLACK BURST's burst needed to match the system phase.
4. Adjust the SPG2A front panel SUBCARRIER PHASE control to correctly position the BLACK BURST signals burst phase.

NOTE

The front panel SUBCARRIER PHASE control should always be adjusted to position the BLACK BURST's burst phase BEFORE the front panel HORIZ DELAY control receives its final adjustment. If this is not done, color framing may be unstable.

5. Release the SYNC/SUBCARRIER LOCK switch (SYNC LOCK).
6. Adjust the front panel HORIZ DELAY control to correctly position the BLACK BURST sync.
7. Depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK). This brings the SCH Phase into compliance with RS170A.

   If a horizontal shift is observed as this is done, there is a potential for color framing instability. Adjust the front panel HORIZ DELAY control to minimize this shift as the SYNC/SUBCARRIER LOCK push button is alternately depressed and released. When done, leave the SPG2A in SUBCARRIER LOCK mode.

The SPG2A will now maintain its SCH Phase even though the SCH Phase of the input may vary.

If the SCH Phase of the reference signal is such that an excessive horizontal shift is required to comply with RS170A, the SPG2A may be placed in SYNC LOCK mode. Then the HORIZ DELAY control may be adjusted to eliminate the shift. In this mode, however, the SPG2A will NOT comply with RS170A.

NOTE

The HORIZ DELAY control has no effect in the INTERNAL mode.

Page 1-4

PERFORMANCE CHECK, TEST EQUIPMENT, ITEM 9 Video Signal Source.

CHANGE item 9, Video Signal Source **TO READ:**

9. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal. Must have black burst, must be capable of being set for precise SCH Phase (e.g. a Tektronix 1410 with SPG2A; or a Tektronix 1910).

PERFORMANCE CHECK PROCEDURE

DELETE Performance check steps 1, 7, and 8; and **RENUMBER** steps 2 through 6 **AS FOLLOWS:**

CURRENT STEP No.	CHANGE TO
1	DELETE
2	4
3	5
4	6
5	7
6	8
7	DELETE
8	DELETE

ADD New steps 1, 2, and 3 **TO READ:**

1. Check SCH Phase

NOTE

The Video Signal Source must be set for correct SCH Phase

a. Connect the equipment as shown in Fig. 1 of this insert. On the SPG2A, release the INTERNAL push button, depress the EXTERNAL/GEN LOCK push button (GEN LOCK), and depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK)

b. Adjust the Waveform Monitor horizontal position control to place the sync and burst in the viewing area, and set the Waveform Monitor for A-B mode, display at 10 uS, magnifier at X5, and 0.2 VFS.

c. Adjust the SPG2A SUBCARRIER PHASE control to obtain an optimum null of the burst waveform.

d. Set the Vectorscope for external reference, channel A, and vector display. Adjust the channel A gain control to set the burst vector to the outer circle on the graticule (at the compass rose), and adjust the channel A phase control to set the burst vector to the 180° reference point. Check that the calibrated phase control is set to 0°.

e. Re-adjust the SPG2A SUBCARRIER PHASE control slightly, to obtain an optimum null of the leading edges of sync.

f. Adjust the Vectorscope calibrated phase control to return the burst vector to the 180° reference.

g. CHECK – that the calibrated phase readout shows 0° ±15°.

h. Return the Vectorscope calibrated phase control to 0°.

2. Check Horiz Delay

a. On the Waveform Monitor, select A input, 0.5 VFS, X50 mag (0.1 μs/Div), and ext sync. Position the display to place the leading edge of sync within the viewing area.

b. Release the SPG2A INTERNAL push button, depress the EXTERNAL/GEN LOCK push button (GEN LOCK), and depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK).

c. CHECK – that the leading edge of sync moves in 140 ns increments as the SPG2A HORIZ DELAY control is rotated.

d. CHECK – that the burst phase changes 0° ±15° as the SPG2A HORIZ DELAY control is rotated from end to end (the display will jump when the sync jumps).

e. Release the SYNC/SUBCARRIER LOCK push button (SYNC LOCK).

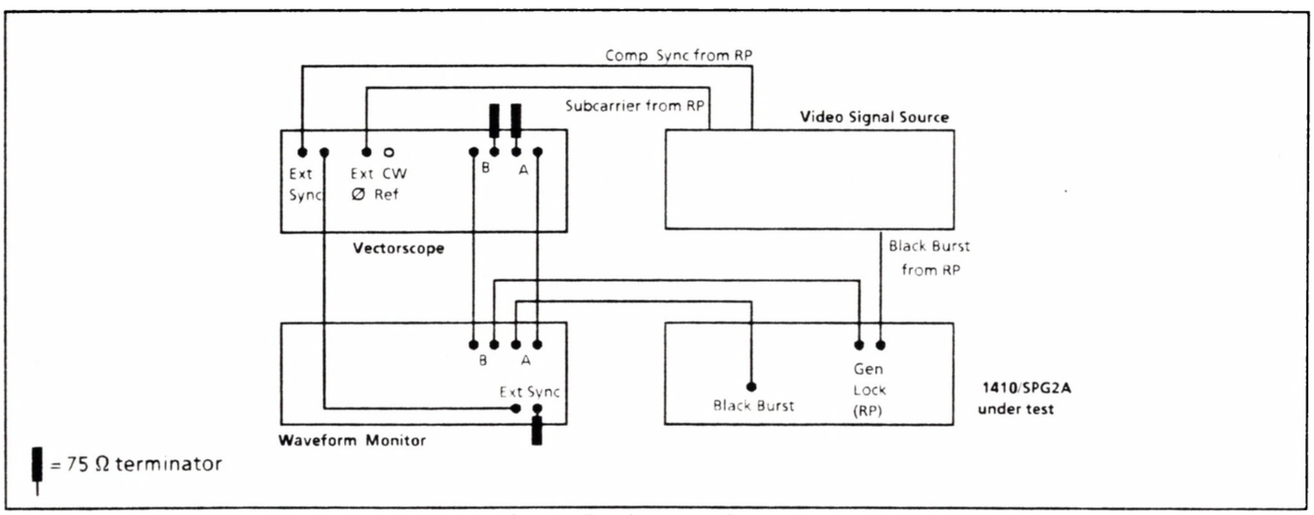


Fig. 1. Equipment Setup

f. CHECK – that the leading edge of sync moves smoothly as the SPG2A HORIZ DELAY control is rotated from end to end, with a total range of > 1 μs.

g. Set the Waveform Monitor to A–B mode, 10 μs/div, X5 mag, and 0.2 VFS. Reposition the display to place the sync and burst in the viewing area.

h. Adjust the SPG2A HORIZ DELAY control to return the sync and burst waveforms to an optimum null.

3. Check SCH Phase Center and Color Framing

a. On the Waveform Monitor, select internal sync, digital line select, line 20, 5 μs/Div, X10, 1.0 VFS, and B input. Use the Waveform Monitor position controls to place the burst in the viewing area. Switch the Waveform Monitor back and forth between fields 1 and 3, until the display shows the first half–cycle of burst greater than 50% of the burst amplitude as a positive–going half–cycle.

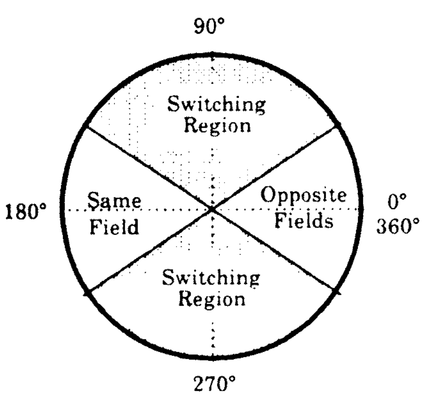
b. Connect the line strobe out from the Waveform Monitor to one input of the Test Oscilloscopes dual trace amplifier. Set the input for 2V/DIV and 10 ms/DIV, and set the Oscilloscope to trigger on this input.

c. Connect the FIELD REF output (J14) from the 1410/SPG2A rear panel to the Test Oscilloscopes other dual trace input. Set the Test Oscilloscope to display both inputs.

d. CHECK – that both pulses are in the same field (±1 ms). Rotate the SPG2A SUBCARRIER PHASE control, while monitoring the Test Oscilloscope and Vectorscope.

e. CHECK – that the two pulses are in the same field when the SPG2A burst phase is between 140° and 220° (±40° relative to the 180° reference).

f. CHECK – that the two pulses are in different fields when the SPG2A burst phase is between 320° and 40° (±140° relative to the 180° reference).



NOTE

The position of the field ref pulse will switch somewhere between the designated angles. That is, it will switch somewhere between 40° and 140°, and somewhere between 220° and 320°. There is approximately 40° of hysteresis in the switching angles.

SECTION 4 RECALIBRATION PROCEDURE

Page 4-1

TEST EQUIPMENT, Item 10 Video Signal Source.

CHANGE item 10, Video Signal Source **TO READ:**

10. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal. Must have black burst, and must be capable of being set for precise SCH Phase (e.g. a Tektronix 1410 with SPG2A; or a Tektronix 1910).

PROCEDURE, Page 4-7, A20 SYNC TIMING procedure

DELETE STEP 10, Check Sync Timing.

Page 4-9, A21 Sync Lock Board

REPLACE A21 Sync Lock Board procedure **WITH THE FOLLOWING:**

A21 Sync Lock Board

1. Initial Setup

NOTE

The Video Signal Source must be set for correct SCH Phase

a. Connect the equipment as shown in Fig 1 of this insert. On the SPG2A, release the INTERNAL push button, and depress the EXTERNAL/GEN LOCK push button (GEN LOCK).

b. Switch S200 on the SPG2A SYNC LOCK board (A21) to position 4 (zero delay). Check that S109 on the SYNC TIMING board (A20) is set with segments 1 and 2 open, segments 3, 4, 5, & 6 closed (factory set position).

c. Set the Waveform Monitor for A-B mode, 10 μs/Div, X5 magnifier, and 0.2 VFS. Adjust the Waveform Monitor position controls to position the sync and burst in the viewing area.

2. Preliminary Adjustments

a. Set R209 and R189 to the center of their ranges. Set R219 completely clockwise, then back it off 1/8 turn.

b. Set R199 completely clockwise, and R198 completely counter–clockwise.

c. Release the SPG2A SYNC/SUBCARRIER LOCK push button (SYNC LOCK).

d. Set the Waveform monitor for A–B operation, 10 µs/Div, 0.2 volts full scale. Position the display to place the sync and burst in the viewing area.

e. ADJUST – the SPG2A SUBCARRIER PHASE control so that the two color bursts cancel out, as shown on the Waveform monitor.

f. ADJUST – the SPG2A HORIZ DELAY control, so that the leading edges of the Black Burst signal sync pulses cancel.

3. Adjust SCH Phase Center (R276)

a. Measure the voltage at TP199. Note the voltage.

b. ADJUST – R276 for the same voltage at TP244 as noted in part a.

4. Adjust SCH Phase (R208)

a. Depress the SPG2A SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK).

b. ADJUST – R208 to re–cancel the leading edges of the BLACK BURST signal sync pulses, as displayed on the Waveform monitor.

5. Adjust SCH Phase Advance (R198) and Retard (R199)

a. Select the Vectorscope channel A input, and set the Vectorscope for a vector display. Rotate the Vectorscope phase control to place the burst vector on the reference mark (180°).

b. Rotate the SPG2A SUBCARRIER PHASE control in a direction that causes the burst vector to move counter–clockwise to 305° (+ 125° from the 180° reference).

c. ADJUST – R198 slowly clockwise while watching the leading edges of the two sync pulses on the Waveform monitor (they will no longer be canceled), until a sudden shift is observed.

d. Rotate the SPG2A SUBCARRIER PHASE control in a direction that causes the burst vector to move clockwise to 235° (305° – 70°).

e. ADJUST – R199 slowly counter–clockwise while watching the leading edge of sync on the Waveform monitor, until a sudden shift is observed.

6. Adjust Color Field Reference Pulse Switch (R219)

a. ADJUST – the SPG2A SUBCARRIER PHASE control to cancel the burst (and sync) as viewed on the Waveform monitor. Note the burst vector phase as displayed on the Vectorscope.

b. Switch the Waveform monitor to display the channel B input. Set the Waveform monitor display to 5 μs/Div, magnifier to 0.5 μs/Div, and 1.0 volts full scale. Adjust the Waveform monitor horizontal position control to display the color burst.

c. Set the waveform monitor to digitally select line 20, with all fields off. Switch between field 1 and field 3 until the first half cycle of subcarrier over 50% of the burst amplitude is positive going.

d. Connect the Waveform monitor line strobe output to one input of the Test Oscilloscope dual trace amplifier.

e. Connect the SPG2A FIELD REF pulse from the 1410 rear–panel to the other Test Oscilloscope dual trace input.

f. Set the Test Oscilloscope to trigger off the line strobe from the Waveform monitor. Set the vertical amplifier to 2V/Div, and the time base to 10 ms/Div.

g. Release the SYNC/SUBCARRIER LOCK push button on the SPG2A (SYNC LOCK).

h. CHECK – that the line strobe and the FIELD REF pulse are in the same field, ±1 ms.

i. Rotate the SPG2A SUBCARRIER PHASE control so that the vector displayed on the Vectorscope moves in a clockwise direction, to 90° from the phase angle noted in part a of this step.

h. ADJUST – R219 slowly counter–clockwise to the point where the Field Ref pulse just switches fields. Ideally, the Field Ref pulse will jump back and forth from field to field.

SECTION 5, THEORY OF OPERATION, DIAGRAM 2a

Page 5-6, **PRECEDING** Sync Phase Comparator description **ADD:** Horizontal Delay description **AS FOLLOWS:**

Horizontal Delay

When the horizontal reference pulse is received at Interface line 87, its rising edge triggers U198B. U198B's $\overline{Q}$ output goes low, causing U195 to load the digital word at its parallel inputs (1010). As soon as it is loaded U195-15 goes low, driving U195-9 high. This allows U195 to start counting the 2fsc clock from U299-8. U195 is used in a divide-by-six application, so its output at pin 12 is fsc/3. This output is used to clock U197.

When U198B is triggered, so is U198A. U198A's $\overline{Q}$ output also goes low, causing U197 to load the digital word at its parallel inputs. This digital word is selected by S200, which is factory set to position 4. U197-15 then goes low (unless S200 is set to position 0), which clears U198A and enables U197 to start counting at the fsc/3 clock rate.

U197-15 going low also turns off Q190. This interrupts the timing current to U198B, which stops its timing cycle.

U197 then counts from the digital word set by S200 to its maximum count, at which time U197-15 returns to a high level. The time that U197-15 stays low can be as much as 12.5 μs, if S200 is set to position F (0000). If S200 is set to position 0 (1111), U197-15 will not go low at all, and the delay is then controlled by the HORIZ DELAY control alone.

When U197-15 returns high, Q190 is turned back on. This allows U198B to finish its timing cycle. When it does, then its $\overline{Q}$ output goes high, triggering U200A.

U200A is another one-shot, whose timing cycle is fixed by R202 and C202. Its function is to generate the delayed horizontal reference pulse, and apply it to pin 2 of U334A in the Sync Phase Comparator.

Page 5-6, **Sync Phase Comparator** description

CHANGE: First Paragraph **TO READ:**

The delayed horizontal reference pulse, from the Horizontal Delay circuitry, through U334A, switches diode switch CR270-CR271 (CR271 is normally conducting). Q260 generates a positive-going ramp that is clamped by Q262. At the falling edge of the delayed horizontal reference pulse, the diode switch reverts to its normal condition, and the output of Q260 ramps back to ground.

DIAGRAM 2b, Page 5-7, Sync-Subcarrier Lock description

CHANGE third paragraph **TO READ:**

At the same time that the ramp is being started, H sync from Sync Timing board A20 clocks U325A. U325A generates a 500 ns sample pulse that occurs during the leading edge of Q315's ramp. The sample pulse turns off Q312, which turns on Q304 and allows the ramp level at that time to be stored in memory capacitor C295.

SECTION 10, REPLACEABLE ELECTRICAL PARTS,

CHANGE TO READ:

A21	670-9231-00	Sync Lock Bd.
A22	670-4448-09	Generator Logic Bd.
C202	281-0852-00	CAP.,FXD,CER DI:1800 pF,10%,100V
R202	315-0223-00	RES.,FXD,CMPSN:22K,5%,0.25W
R395	321-0414-00	RES.,FXD,CMPSN:200K,5%,0.125W
R396	321-0409-00	RES.,FXD,CMPSN:178K,1%,0.125W

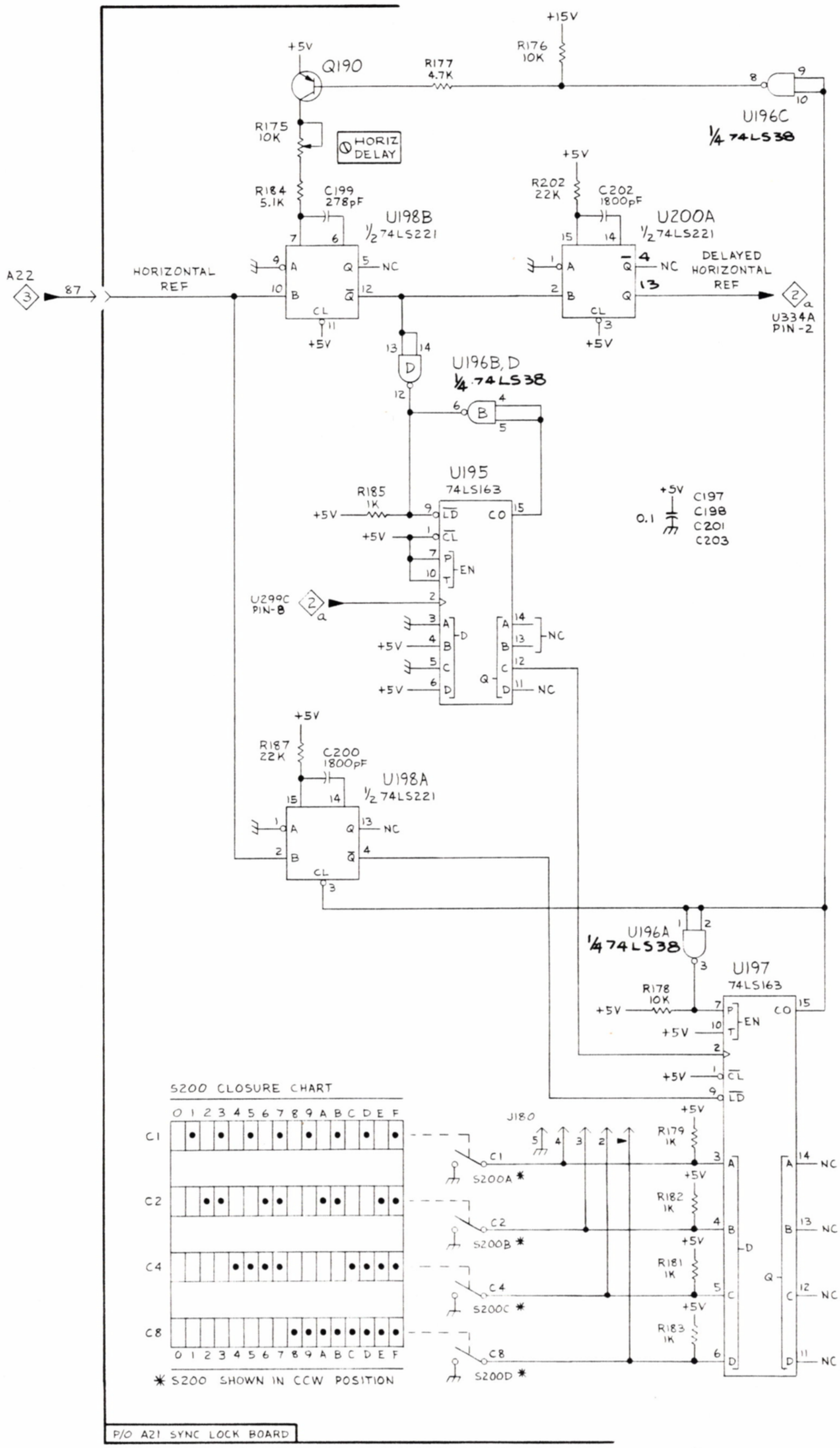
ADD:

C196	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C197	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C198	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C199	283-0769-00	CAP.,FXD,MICA:278 pF,1%,500VDC
C200	281-0852-00	CAP.,FXD,CER DI:1800 pF,10%,100V
C201	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C203	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
Q190	151-0221-00	TRANSISTOR:NPN,SI
R176	315-0103-00	RES.,FXD,CMPSN:10K,5%,0.25W
R177	315-0472-00	RES.,FXD,CMPSN:4.7K,5%,0.25W
R178	315-0103-00	RES.,FXD,CMPSN:10K,5%,0.25W
R179	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R181	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R182	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R183	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R184	315-0512-00	RES.,FXD,CMPSN:5.1K,5%,0.25W

ADD (Cont.):

R185	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R187	315-0223-00	RES.,FXD,CMPSN:22K,5%,0.25W
S200	260-2126-00	SWITCH,ROTARY,16 POS,HEX-DEC OUT
U195	156-0784-02	MICROCKT:SYN 4-bit BINARY COUNTER
U196	156-0467-02	QUAD,2-INPUT NAND BFR,W/OC OUTPUTS
U197	156-0784-02	MICROCKT:SYN 4-bit BINARY COUNTER
U198	156-0733-02	MICROCKT:DUAL MONOSTABLE MULTIVIBRATOR

Date: 03-20-86	Group Code 20	Change Reference: M58637
Product: SPG2		Manual Part No: 070-2104-00



ADDED CIRCUITRY FOR SCH PHASE MOD, SCHEMATIC 2a, SPG 2

Tektronix

COMMITTED TO EXCELLENCE

MANUAL CHANGE INFORMATION

Group Code 20

Date: 7-14-86 Change Reference: M61069

Product: SEE LIST Manual Part No: SEE LIST

DESCRIPTION

SPG2A	070-2104-00	EFF SN B033552
1410R	070-2759-00	EFF SN B040881
SPG12	070-2324-00	EFF SN B022857
1411R	070-2322-00	EFF SN B023139
SPG22	070-2326-00	EFF SN B010155
1412R	070-2323-00	EFF SN B020155

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO READ:

			Schematic
A23	670-4449-10	CKT BD ASSY: SUBCARRIER LOCK (SPG2A)	4a
A23-1	670-4449-11	CKT BD ASSY: SUBCARRIER LOCK (SPG12)	7
A23-2	670-4449-12	CKT BD ASSY: SUBCARRIER LOCK (SPG22)	7
C690	283-0339-00	CAP,FXD,CER DI 0.22µF,10%,50V	

DESCRIPTION

SPG2A

The SPG2A is a modified Sync Generator module for the 1410 Generator. The purpose of this modification is to ensure that SCH Phasing will remain in compliance with RS170A throughout the Horiz Delay range.

The Horiz Delay circuit, consisting of U200A, R202, R175, and C202, has been removed from its location in the Sync Subcarrier Lock circuitry (shown on schematic 2b). U325–5 now receives its input directly from Interface line 3.

New circuitry has been added, in line at the horizontal reference input, to the Sync Phase Comparator circuitry (shown on schematic 2a), to handle the HORIZ DELAY function. See the partial schematic 2a included with this insert.

Essentially, this added circuitry delays the application of the horizontal reference pulse, from Interface line 87, to the Sync Phase Comparator circuitry.

When the horizontal reference pulse is received at Interface line 87, its rising edge triggers U198B, a one–shot. U198B effects the delay of the horizontal reference pulse. U198B's timing is affected by the HORIZ DELAY control, which varies the timing current; and by U197, which turns the timing current off for a length of time controlled by S200.

After U198B times out it triggers U200A, another one–shot. U200A generates the delayed horizontal reference pulse, and applies it to the Sync Phase Comparator.

Due to the impact of this change, the following information is being provided to cover the changes in the circuitry and procedures.

TEXT, PARTS LIST, and SCHEMATIC CHANGES

CHANGE Manual part number **TO:** 070-2104-01.

DELETE all references to SPG1, and **CHANGE** all references to SPG2 **TO READ:** SPG2A.

Page 1-2

SECTION 1 OPERATING INSTRUCTIONS, FRONT PANEL CONTROLS, Item 5.

CHANGE Item 5 **TO READ:**

5 HORIZ DELAY – Delays sync ± 1 μs with respect to incoming Sync Reference. A wider range can be selected, via S200 (Incremental H Delay) on the A21 SYNC LOCK board. In SYNC LOCK mode the delay is continuous, independent of subcarrier phase. In SUBCARRIER LOCK mode the delay is held to discrete values which are dependent on subcarrier phase. In INTERNAL mode this control has no effect. See system timing instructions for details.

Page 1-3

PRECEDING PERFORMANCE CHECK, **ADD** SYSTEM TIMING **AS FOLLOWS:**

SYSTEM TIMING

There are three controls provided for timing the SPG2A into your system, in GEN LOCK or EXTERNAL modes:

1. Front panel SUBCARRIER PHASE control (360°).
2. Front panel HORIZ DELAY control (± 1 μs).
3. Internal Incremental H Delay switch, S200 on the A21 SYNC LOCK board (+4, -10 μs, in 3 subcarrier-cycle increments).

Timing the SPG2A To Your System

1. Lock the SPG2A to its reference source.

2. Adjust the Incremental H Delay switch, S200 on the A21 SYNC LOCK board, to place the SPG2A BLACK BURST sync leading edge to within 1 μs of that of the system you are matching.

3. Determine the phase of the BLACK BURST's burst needed to match the system phase.

4. Adjust the SPG2A front panel SUBCARRIER PHASE control to correctly position the BLACK BURST signals burst phase.

NOTE

The front panel SUBCARRIER PHASE control should always be adjusted to position the BLACK BURST's burst phase BEFORE the front panel HORIZ DELAY control receives its final adjustment. If this is not done, color framing may be unstable.

5. Release the SYNC/SUBCARRIER LOCK switch (SYNC LOCK).

6. Adjust the front panel HORIZ DELAY control to correctly position the BLACK BURST sync.

7. Depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK). This brings the SCH Phase into compliance with RS170A.

   If a horizontal shift is observed as this is done, there is a potential for color framing instability. Adjust the front panel HORIZ DELAY control to minimize this shift as the SYNC/SUBCARRIER LOCK push button is alternately depressed and released. When done, leave the SPG2A in SUBCARRIER LOCK mode.

The SPG2A will now maintain its SCH Phase even though the SCH Phase of the input may vary.

If the SCH Phase of the reference signal is such that an excessive horizontal shift is required to comply with RS170A, the SPG2A may be placed in SYNC LOCK mode. Then the HORIZ DELAY control may be adjusted to eliminate the shift. In this mode, however, the SPG2A will NOT comply with RS170A.

NOTE

The HORIZ DELAY control has no effect in the INTERNAL mode.

Page 1-4

PERFORMANCE CHECK, TEST EQUIPMENT, ITEM 9 Video Signal Source.

CHANGE item 9, Video Signal Source **TO READ:**

9. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal. Must have black burst, must be capable of being set for precise SCH Phase (e.g. a Tektronix 1410 with SPG2A; or a Tektronix 1910).

PERFORMANCE CHECK PROCEDURE

DELETE Performance check steps 1, 7, and 8; and **RENUMBER** steps 2 through 6 **AS FOLLOWS:**

CURRENT STEP No.	CHANGE TO
1	DELETE
2	4
3	5
4	6
5	7
6	8
7	DELETE
8	DELETE

ADD New steps 1, 2, and 3 **TO READ:**

1. Check SCH Phase

NOTE

The Video Signal Source must be set for correct SCH Phase

a. Connect the equipment as shown in Fig. 1 of this insert. On the SPG2A, release the INTERNAL push button, depress the EXTERNAL/GEN LOCK push button (GEN LOCK), and depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK)

b. Adjust the Waveform Monitor horizontal position control to place the sync and burst in the viewing area, and set the Waveform Monitor for A-B mode, display at 10 uS, magnifier at X5, and 0.2 VFS.

c. Adjust the SPG2A SUBCARRIER PHASE control to obtain an optimum null of the burst waveform.

d. Set the Vectorscope for external reference, channel A, and vector display. Adjust the channel A gain control to set the burst vector to the outer circle on the graticule (at the compass rose), and adjust the channel A phase control to set the burst vector to the 180° reference point. Check that the calibrated phase control is set to 0°.

e. Re-adjust the SPG2A SUBCARRIER PHASE control slightly, to obtain an optimum null of the leading edges of sync.

f. Adjust the Vectorscope calibrated phase control to return the burst vector to the 180° reference.

g. CHECK - that the calibrated phase readout shows 0° ±15°.

h. Return the Vectorscope calibrated phase control to 0°.

2. Check Horiz Delay

a. On the Waveform Monitor, select A input, 0.5 VFS, X50 mag (0.1 μs/Div), and ext sync. Position the display to place the leading edge of sync within the viewing area.

b. Release the SPG2A INTERNAL push button, depress the EXTERNAL/GEN LOCK push button (GEN LOCK), and depress the SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK).

c. CHECK - that the leading edge of sync moves in 140 ns increments as the SPG2A HORIZ DELAY control is rotated.

d. CHECK - that the burst phase changes 0° ±15° as the SPG2A HORIZ DELAY control is rotated from end to end (the display will jump when the sync jumps).

e. Release the SYNC/SUBCARRIER LOCK push button (SYNC LOCK).

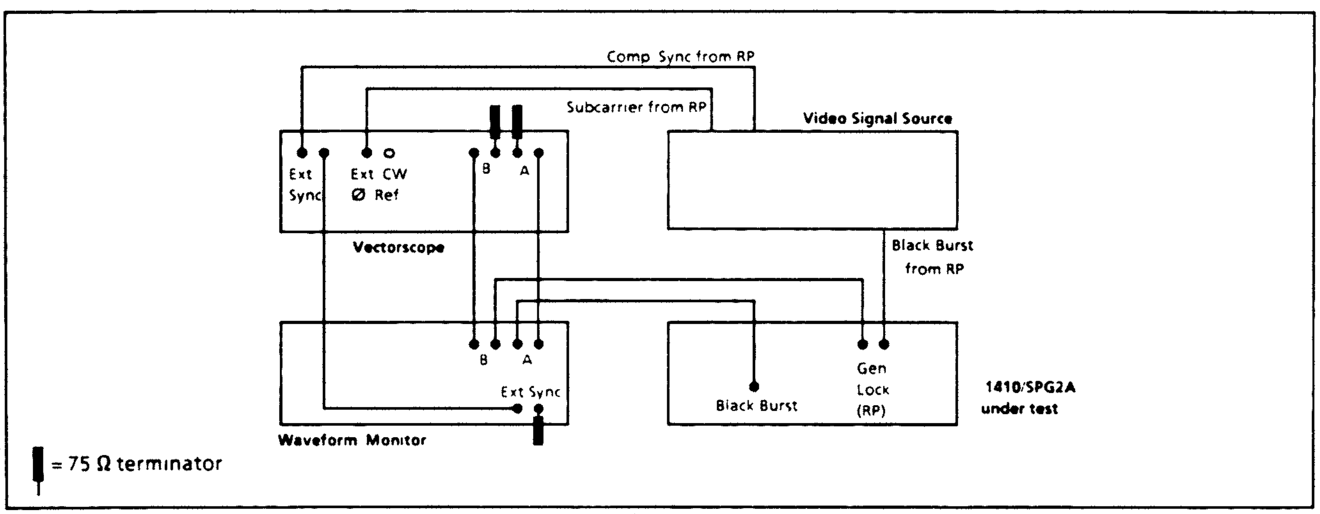


Fig. 1. Equipment Setup

f. CHECK – that the leading edge of sync moves smoothly as the SPG2A HORIZ DELAY control is rotated from end to end, with a total range of > 1 μs.

g. Set the Waveform Monitor to A–B mode, 10 μs/div, X5 mag, and 0.2 VFS. Reposition the display to place the sync and burst in the viewing area.

h. Adjust the SPG2A HORIZ DELAY control to return the sync and burst waveforms to an optimum null.

3. Check SCH Phase Center and Color Framing

a. On the Waveform Monitor, select internal sync, digital line select, line 20, 5 μs/Div, X10, 1.0 VFS, and B input. Use the Waveform Monitor position controls to place the burst in the viewing area. Switch the Waveform Monitor back and forth between fields 1 and 3, until the display shows the first half–cycle of burst greater than 50% of the burst amplitude as a positive–going half–cycle.

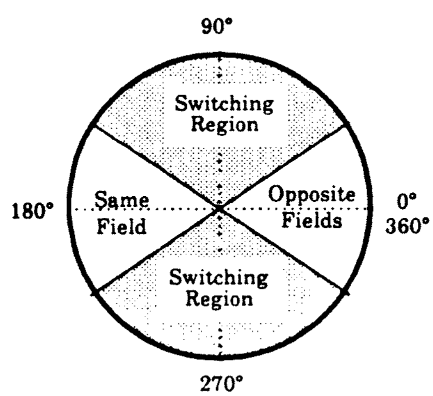
b. Connect the line strobe out from the Waveform Monitor to one input of the Test Oscilloscopes dual trace amplifier. Set the input for 2V/DIV and 10 ms/DIV, and set the Oscilloscope to trigger on this input.

c. Connect the FIELD REF output (J14) from the 1410/SPG2A rear panel to the Test Oscilloscopes other dual trace input. Set the Test Oscilloscope to display both inputs.

d. CHECK – that both pulses are in the same field (±1 ms). Rotate the SPG2A SUBCARRIER PHASE control, while monitoring the Test Oscilloscope and Vectorscope.

e. CHECK – that the two pulses are in the same field when the SPG2A burst phase is between 140° and 220° (±40° relative to the 180° reference).

f. CHECK – that the two pulses are in different fields when the SPG2A burst phase is between 320° and 40° (±140° relative to the 180° reference).



NOTE

The position of the field ref pulse will switch somewhere between the designated angles. That is, it will switch somewhere between 40° and 140°, and somewhere between 220° and 320°. There is approximately 40° of hysteresis in the switching angles.

SECTION 4 RECALIBRATION PROCEDURE

Page 4–1

TEST EQUIPMENT, Item 10 Video Signal Source.

CHANGE item 10, Video Signal Source **TO READ:**

10. Video Signal Source

Capable of generating composite video, composite sync, and a 2 volt peak-to-peak subcarrier signal. Must have black burst, and must be capable of being set for precise SCH Phase (e.g. a Tektronix 1410 with SPG2A; or a Tektronix 1910).

PROCEDURE, Page 4–7, A20 SYNC TIMING procedure

DELETE STEP 10, Check Sync Timing.

Page 4–9, A21 Sync Lock Board

REPLACE A21 Sync Lock Board procedure **WITH THE FOLLOWING:**

A21 Sync Lock Board

1. Initial Setup

NOTE

The Video Signal Source must be set for correct SCH Phase

a. Connect the equipment as shown in Fig 1 of this insert. On the SPG2A, release the INTERNAL push button, and depress the EXTERNAL/GEN LOCK push button (GEN LOCK).

b. Switch S200 on the SPG2A SYNC LOCK board (A21) to position 4 (zero delay). Check that S109 on the SYNC TIMING board (A20) is set with segments 1 and 2 open, segments 3, 4, 5, & 6 closed (factory set position).

c. Set the Waveform Monitor for A–B mode, 10 μs/Div, X5 magnifier, and 0.2 VFS. Adjust the Waveform Monitor position controls to position the sync and burst in the viewing area.

2. Preliminary Adjustments

a. Set R209 and R189 to the center of their ranges. Set R219 completely clockwise, then back it off 1/8 turn.

b. Set R199 completely clockwise, and R198 completely counter-clockwise.

c. Release the SPG2A SYNC/SUBCARRIER LOCK push button (SYNC LOCK).

d. Set the Waveform monitor for A-B operation, 10 μs/Div, 0.2 volts full scale. Position the display to place the sync and burst in the viewing area.

e. ADJUST - the SPG2A SUBCARRIER PHASE control so that the two color bursts cancel out, as shown on the Waveform monitor.

f. ADJUST - the SPG2A HORIZ DELAY control, so that the leading edges of the Black Burst signal sync pulses cancel.

3. Adjust SCH Phase Center (R276)

a. Measure the voltage at TP199. Note the voltage.

b. ADJUST - R276 for the same voltage at TP244 as noted in part a.

4. Adjust SCH Phase (R208)

a. Depress the SPG2A SYNC/SUBCARRIER LOCK push button (SUBCARRIER LOCK).

b. ADJUST - R208 to re-cancel the leading edges of the BLACK BURST signal sync pulses, as displayed on the Waveform monitor.

5. Adjust SCH Phase Advance (R198) and Retard (R199)

a. Select the Vectorscope channel A input, and set the Vectorscope for a vector display. Rotate the Vectorscope phase control to place the burst vector on the reference mark (180°).

b. Rotate the SPG2A SUBCARRIER PHASE control in a direction that causes the burst vector to move counter-clockwise to 305° (+125° from the 180° reference).

c. ADJUST - R198 slowly clockwise while watching the leading edges of the two sync pulses on the Waveform monitor (they will no longer be canceled), until a sudden shift is observed.

d. Rotate the SPG2A SUBCARRIER PHASE control in a direction that causes the burst vector to move clockwise to 235° (305° - 70°).

e. ADJUST - R199 slowly counter-clockwise while watching the leading edge of sync on the Waveform monitor, until a sudden shift is observed.

6. Adjust Color Field Reference Pulse Switch (R219)

a. ADJUST - the SPG2A SUBCARRIER PHASE control to cancel the burst (and sync) as viewed on the Waveform monitor. Note the burst vector phase as displayed on the Vectorscope.

b. Switch the Waveform monitor to display the channel B input. Set the Waveform monitor display to 5 μs/Div, magnifier to 0.5 μs/Div, and 1.0 volts full scale. Adjust the Waveform monitor horizontal position control to display the color burst.

c. Set the waveform monitor to digitally select line 20, with all fields off. Switch between field 1 and field 3 until the first half cycle of subcarrier over 50% of the burst amplitude is positive going.

d. Connect the Waveform monitor line strobe output to one input of the Test Oscilloscope dual trace amplifier.

e. Connect the SPG2A FIELD REF pulse from the 1410 rear-panel to the other Test Oscilloscope dual trace input.

f. Set the Test Oscilloscope to trigger off the line strobe from the Waveform monitor. Set the vertical amplifier to 2V/Div, and the time base to 10 ms/Div.

g. Release the SYNC/SUBCARRIER LOCK push button on the SPG2A (SYNC LOCK).

h. CHECK - that the line strobe and the FIELD REF pulse are in the same field, ±1 ms.

i. Rotate the SPG2A SUBCARRIER PHASE control so that the vector displayed on the Vectorscope moves in a clockwise direction, to 90° from the phase angle noted in part a of this step.

h. ADJUST - R219 slowly counter-clockwise to the point where the Field Ref pulse just switches fields. Ideally, the Field Ref pulse will jump back and forth from field to field.

SECTION 5, THEORY OF OPERATION, DIAGRAM 2a

Page 5–6, **PRECEDING** Sync Phase Comparator description **ADD:** Horizontal Delay description **AS FOLLOWS:**

Horizontal Delay

When the horizontal reference pulse is received at Interface line 87, its rising edge triggers U198B. U198B's $\overline{Q}$ output goes low, causing U195 to load the digital word at its parallel inputs (1010). As soon as it is loaded U195–15 goes low, driving U195–9 high. This allows U195 to start counting the 2fsc clock from U299–8. U195 is used in a divide–by–six application, so its output at pin 12 is fsc/3. This output is used to clock U197.

When U198B is triggered, so is U198A. U198A's $\overline{Q}$ output also goes low, causing U197 to load the digital word at its parallel inputs. This digital word is selected by S200, which is factory set to position 4. U197–15 then goes low (unless S200 is set to position 0), which clears U198A and enables U197 to start counting at the fsc/3 clock rate.

U197–15 going low also turns off Q190. This interrupts the timing current to U198B, which stops its timing cycle.

U197 then counts from the digital word set by S200 to its maximum count, at which time U197–15 returns to a high level. The time that U197–15 stays low can be as much as 12.5 μs, if S200 is set to position F (0000). If S200 is set to position 0 (1111), U197–15 will not go low at all, and the delay is then controlled by the HORIZ DELAY control alone.

When U197–15 returns high, Q190 is turned back on. This allows U198B to finish its timing cycle. When it does, then its $\overline{Q}$ output goes high, triggering U200A.

U200A is another one–shot, whose timing cycle is fixed by R202 and C202. Its function is to generate the delayed horizontal reference pulse, and apply it to pin 2 of U334A in the Sync Phase Comparator.

Page 5–6, **Sync Phase Comparator** description

CHANGE: First Paragraph **TO READ:**

The delayed horizontal reference pulse, from the Horizontal Delay circuitry, through U334A, switches diode switch CR270–CR271 (CR271 is normally conducting). Q260 generates a positive-going ramp that is clamped by Q262. At the falling edge of the delayed horizontal reference pulse, the diode switch reverts to its normal condition, and the output of Q260 ramps back to ground.

Date: 4/28/87	Group Code 20	Change Reference:	M58637 Rev 1 & M60983
Product: SPG2		Manual Part No:	070-2104-00

DIAGRAM 2b, Page 5–7, **Sync–Subcarrier Lock** description

CHANGE third paragraph **TO READ:**

At the same time that the ramp is being started, H sync from Sync Timing board A20 clocks U325A. U325A generates a 500 ns sample pulse that occurs during the leading edge of Q315's ramp. The sample pulse turns off Q312, which turns on Q304 and allows the ramp level at that time to be stored in memory capacitor C295.

SECTION 10, REPLACEABLE ELECTRICAL PARTS,

CHANGE TO READ:

A21	670-9231-00	Sync Lock Bd.
A21	670-9231-01	Sync Lock Bd (M60983 - EFF SN B033556)
A22	670-4448-09	Generator Logic Bd.
C202	281-0852-00	CAP.,FXD,CER DI:1800 pF,10%,100V
R202	315-0223-00	RES.,FXD,CMPSN:22K,5%,0.25W
R395	321-0414-00	RES.,FXD,CMPSN:200K,5%,0.125W
R396	321-0409-00	RES.,FXD,CMPSN:178K,1%,0.125W

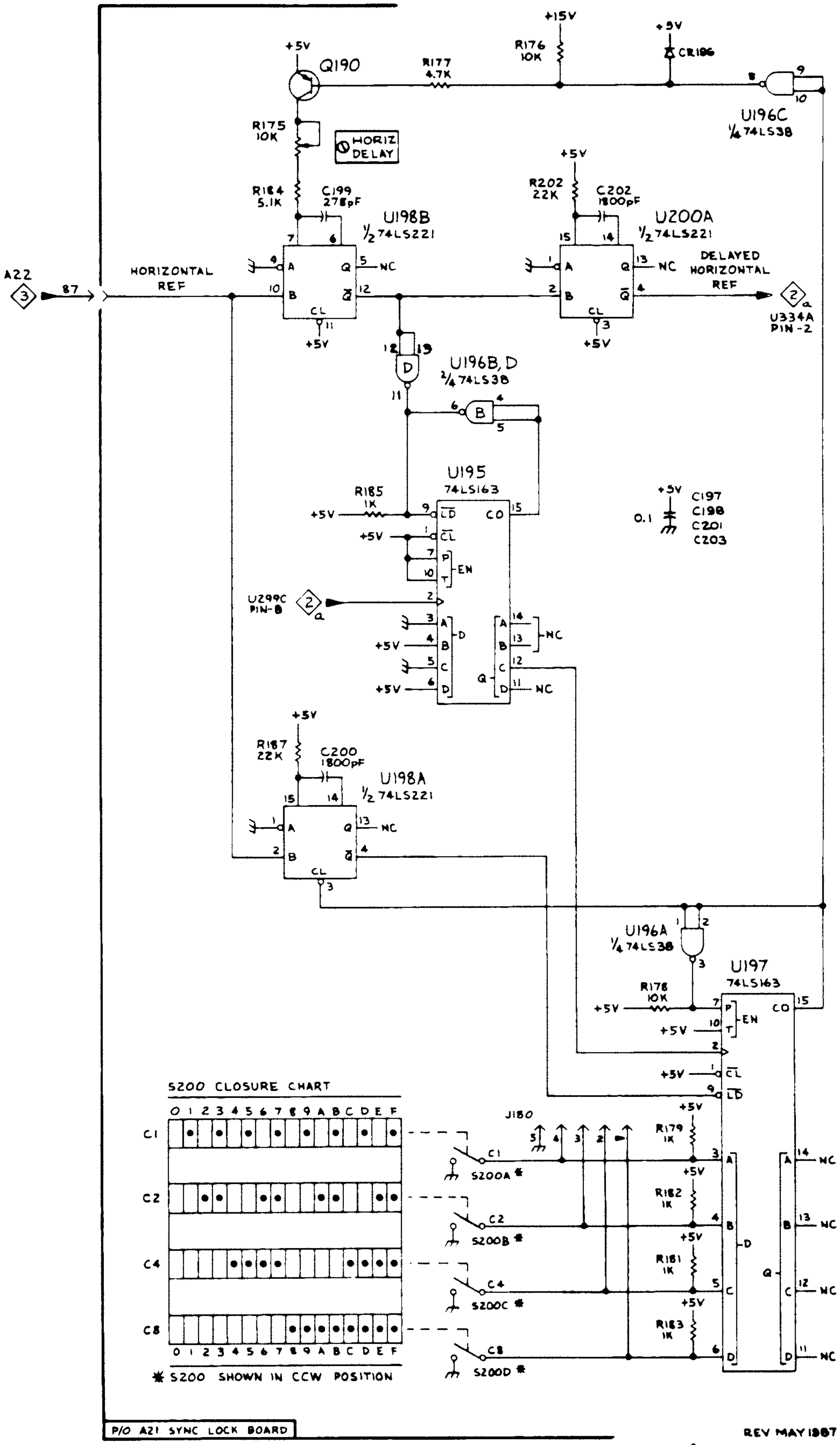
ADD:

C196	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C197	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C198	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C199	283-0769-00	CAP.,FXD,MICA:278 pF,1%,500VDC
C200	281-0852-00	CAP.,FXD,CER DI:1800 pF,10%,100V
C201	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
C203	281-0775-00	CAP.,FXD,CER DI:0.1 uF,20%,50VDC
CR196	152-0141-02	SEMICOND DVC,DI,SW,SI,30V,150MA(M60983 - EFF SN B033556)
Q190	151-0221-00	TRANSISTOR:NPN,SI
R176	315-0103-00	RES.,FXD,CMPSN:10K,5%,0.25W
R177	315-0472-00	RES.,FXD,CMPSN:4.7K,5%,0.25W
R178	315-0103-00	RES.,FXD,CMPSN:10K,5%,0.25W
R179	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R181	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R182	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R183	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R184	315-0512-00	RES.,FXD,CMPSN:5.1K,5%,0.25W

ADD (Cont.):

R185	315-0102-00	RES.,FXD,CMPSN:1K,5%,0.25W
R187	315-0223-00	RES.,FXD,CMPSN:22K,5%,0.25W
S200	260-2126-00	SWITCH,ROTARY,16 POS,HEX-DEC OUT
U195	156-0784-02	MICROCKT:SYN 4-bit BINARY COUNTER
U196	156-0467-02	QUAD,2-INPUT NAND BFR,W/OC OUTPUTS
U197	156-0784-02	MICROCKT:SYN 4-bit BINARY COUNTER
U198	156-0733-02	MICROCKT:DUAL MONOSTABLE MULTIVIBRATOR

Date: 4/28/87	Group Code 20	Change Reference: M58637 Rev 1 & M60983
Product: SPG2		Manual Part No: 070-2104-00



ADDED CIRCUITRY FOR SCH PHASE MOD, SCHEMATIC 2a, SPG 2